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Kitamura et al.

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(54) **LIQUID EJECTING APPARATUS**

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Sep. 3, 2010 (JP) 2010-197836

(51) **Int. Cl.**
B41J 2/165 (2006.01)

(52) **U.S. Cl.** **347/29**

(58) **Field of Classification Search** ..... None
See application file for complete search history.

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(57) **ABSTRACT**

At a front-end side opposite to a head-fixing-member-attachment side, a protection member has an inclined plane sloped up from a head side toward the opposite outer side in a direction in which liquid ejecting heads are arranged in a row. The surface of the front end is located at a position that is not closer to a head-fixing member in comparison with the nozzle surface of each of the liquid ejecting heads attached to the head-fixing member or level therewith. A recess is formed at a part of the inclined plane. In a state in which one of the caps faces the protection member and, in addition, each of the remaining caps is in contact with the nozzle surface of the liquid ejecting head, a part of the cap facing the protection member is in the recess, which ensures that the cap is not in contact with the protection member.

3 Claims, 16 Drawing Sheets

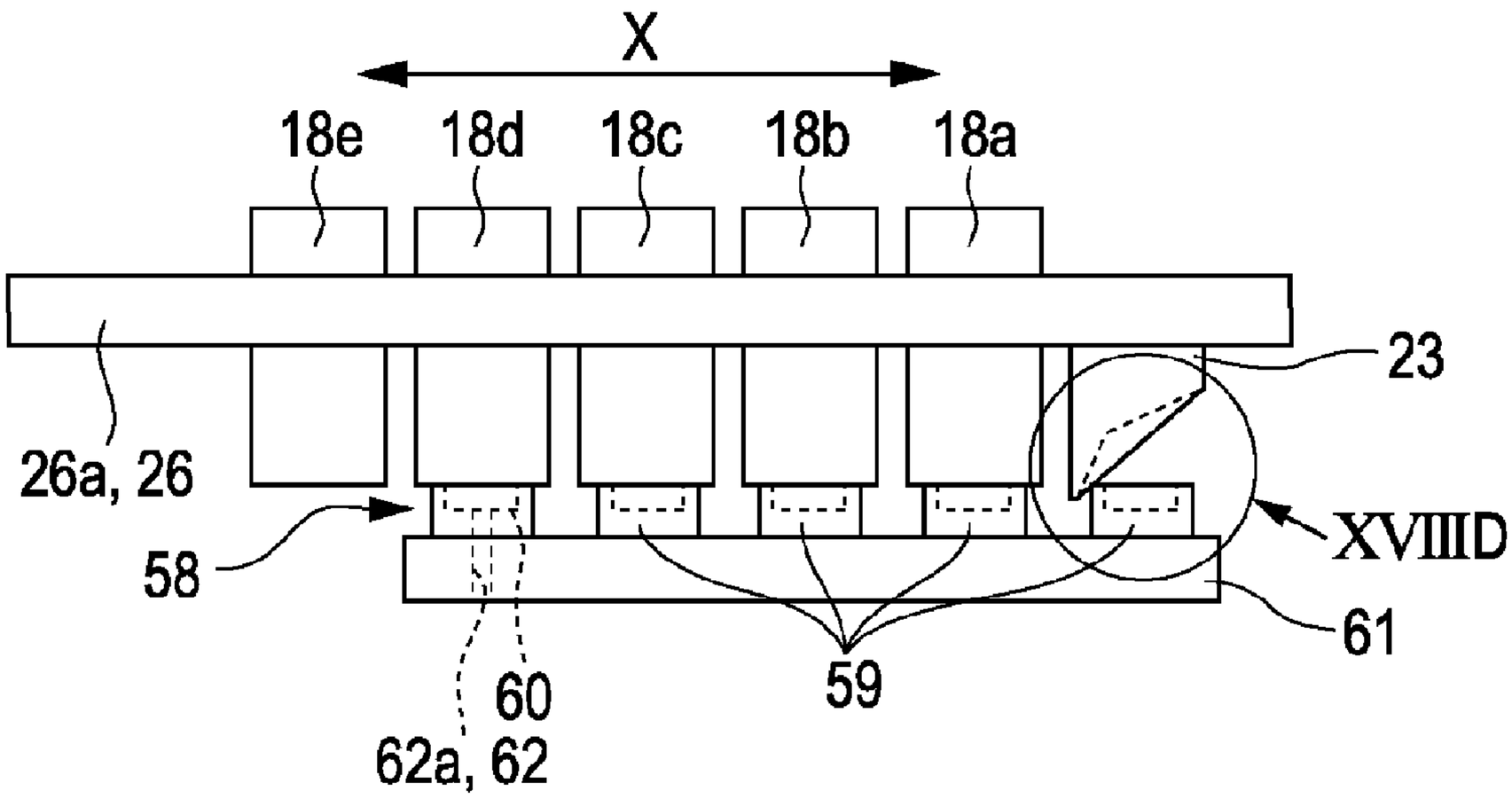


FIG. 1

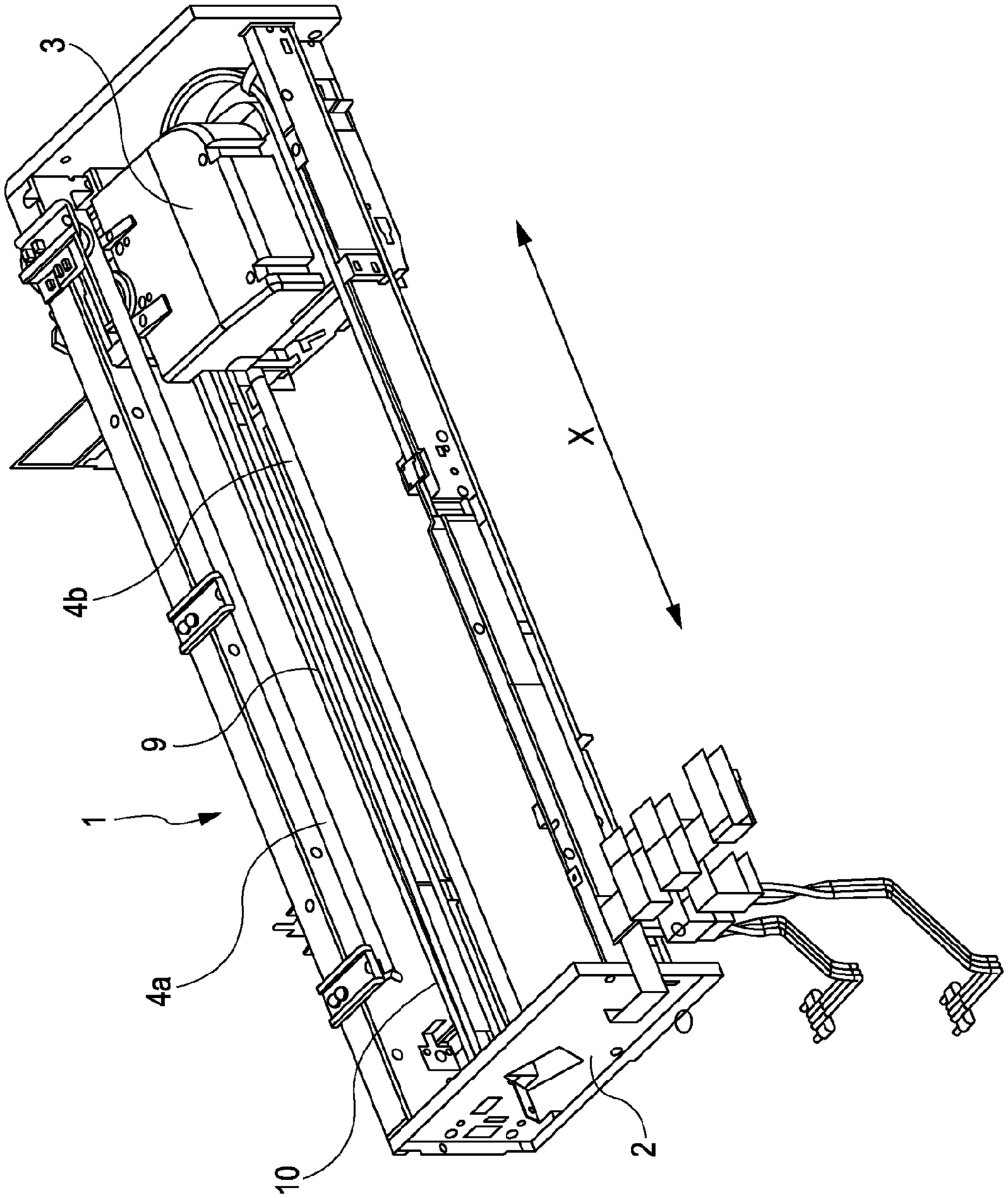


FIG. 2

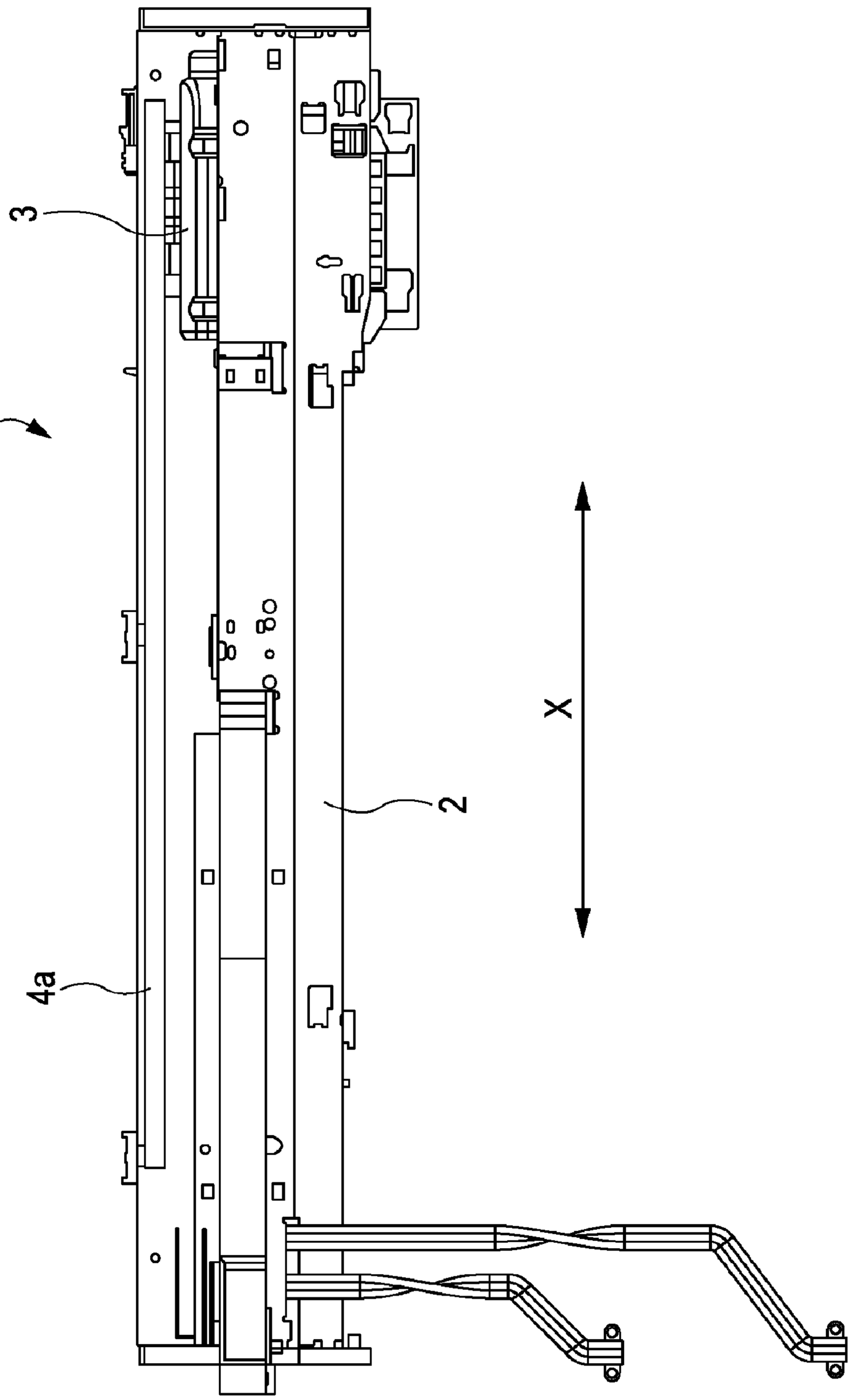


FIG. 3

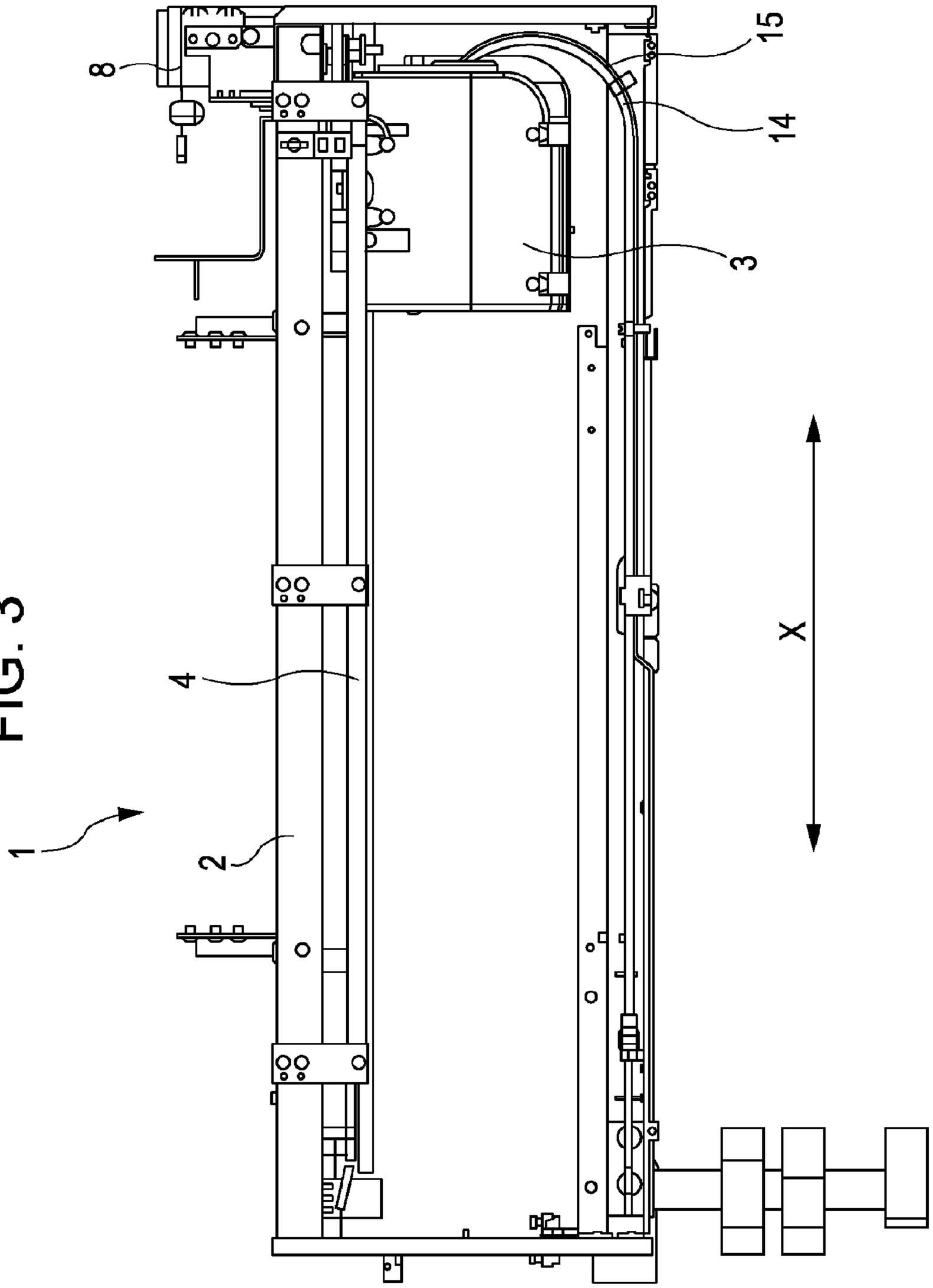


FIG. 4

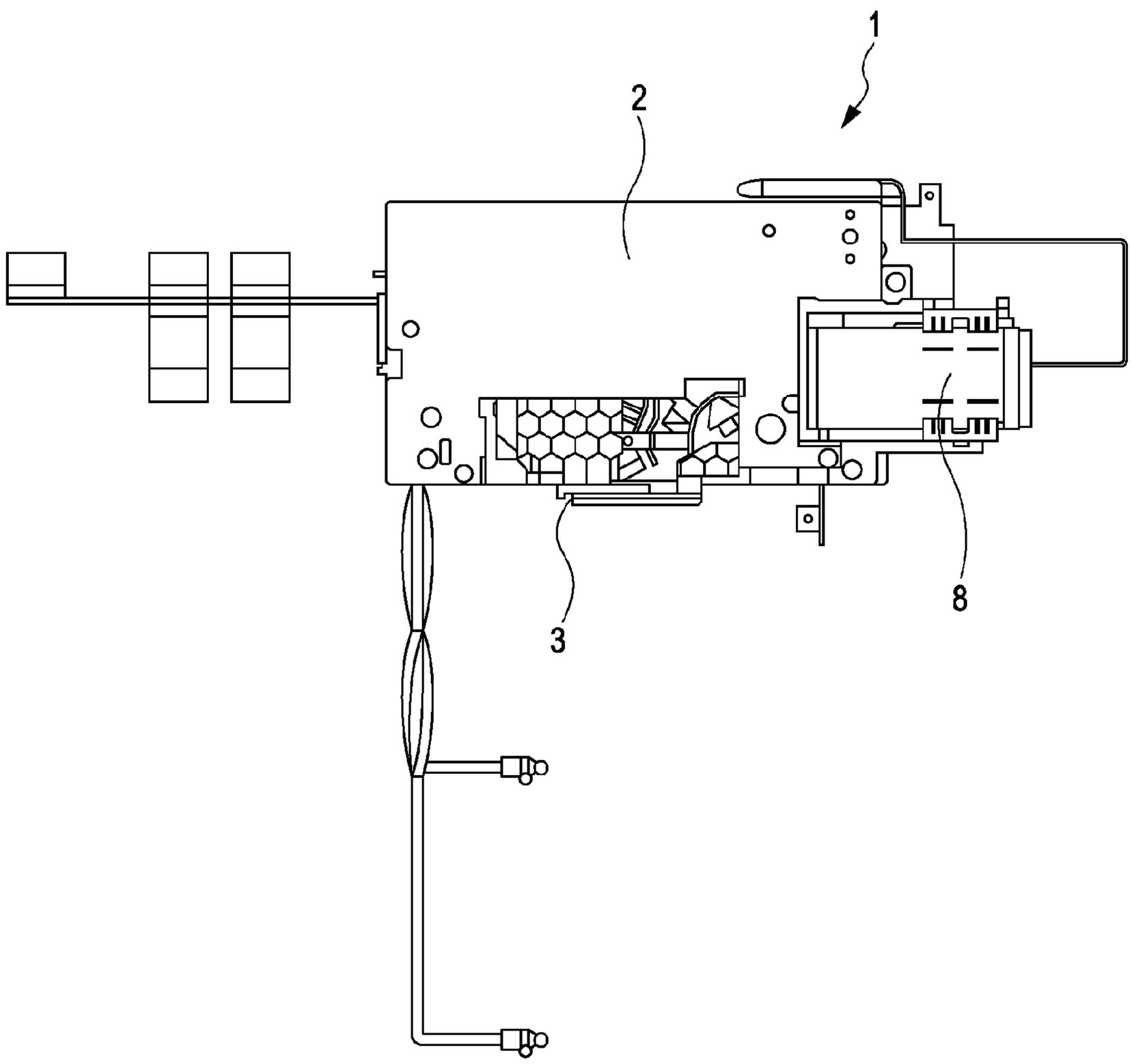
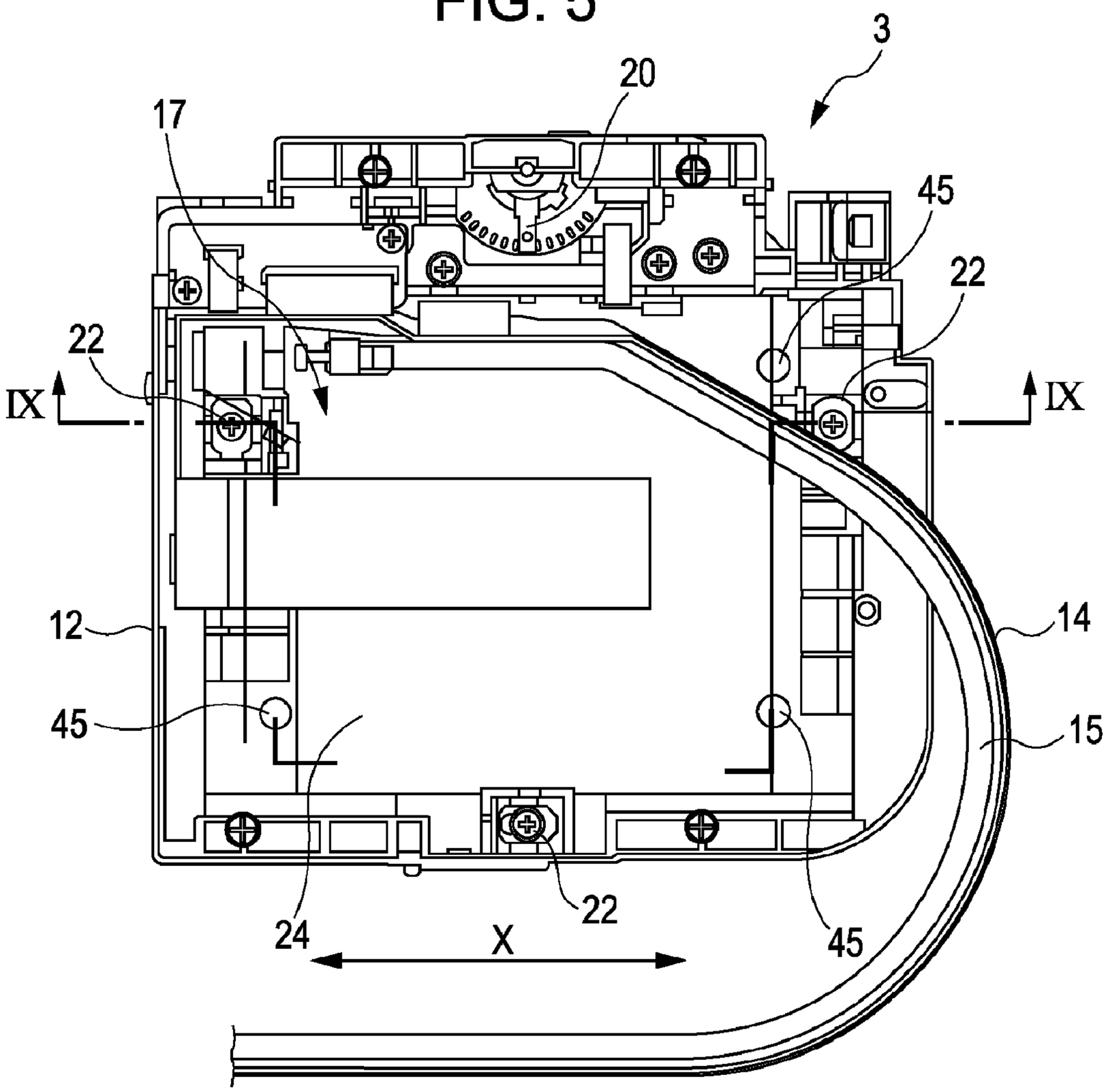


FIG. 5



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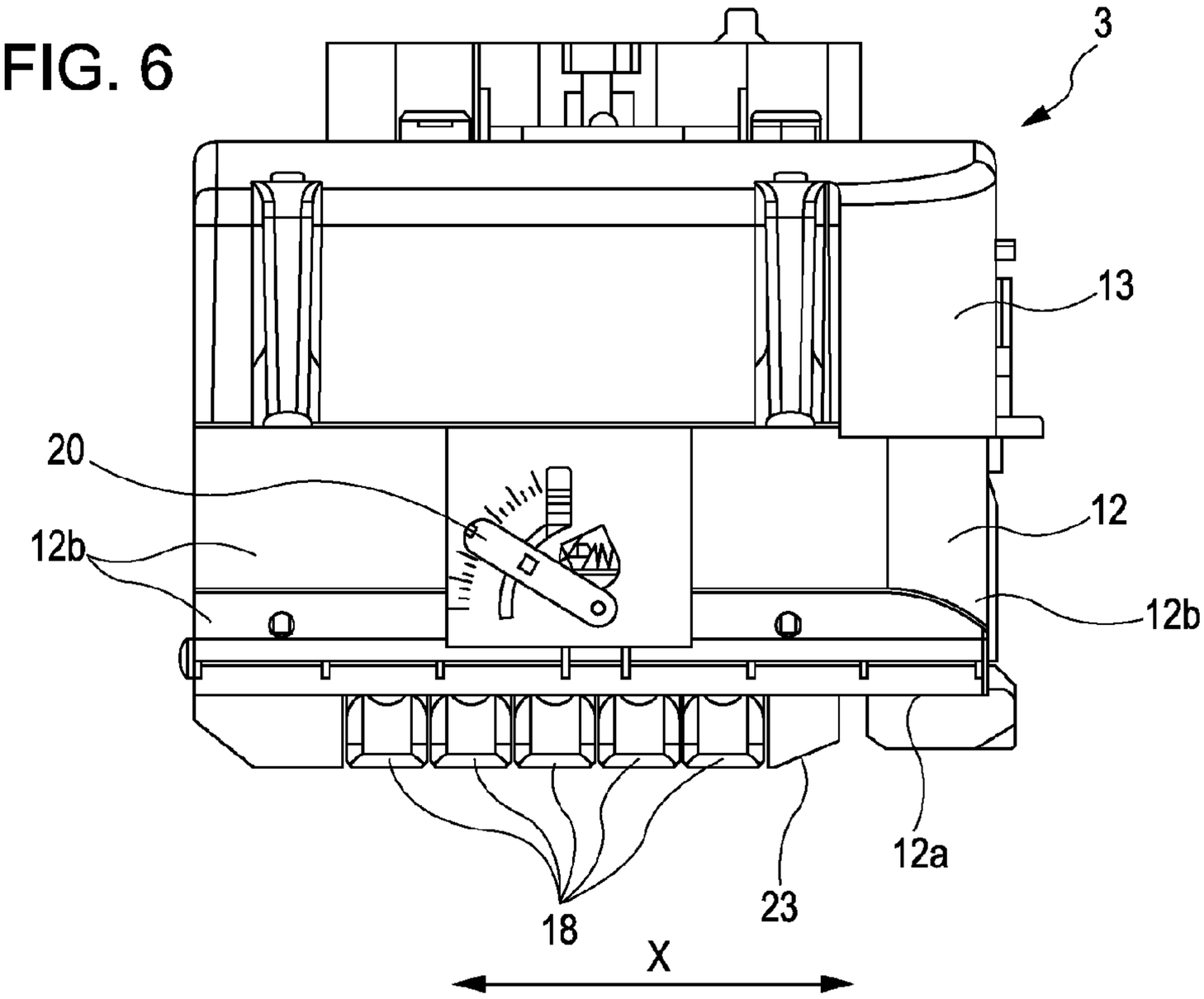

FIG. 7

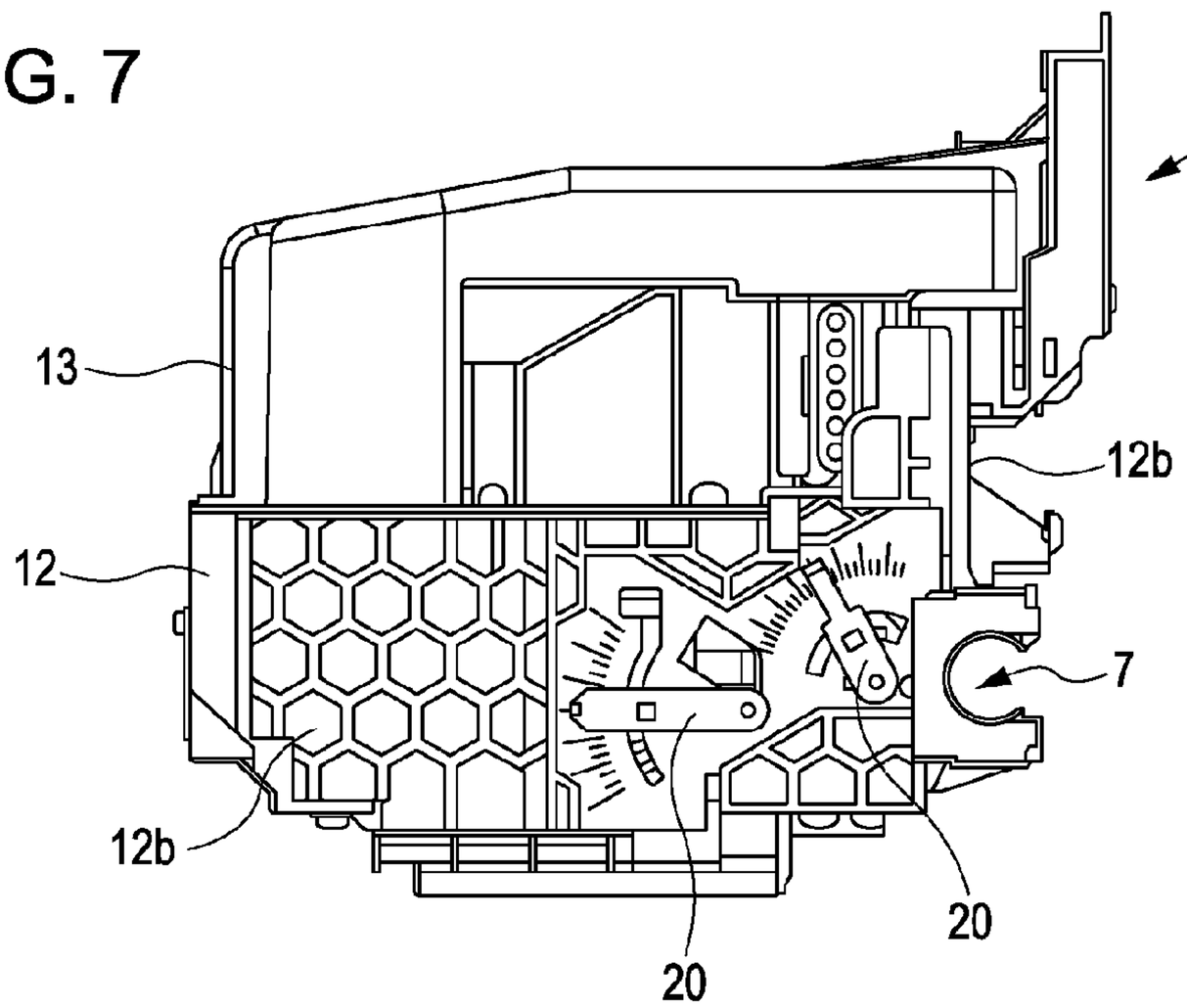

FIG. 8

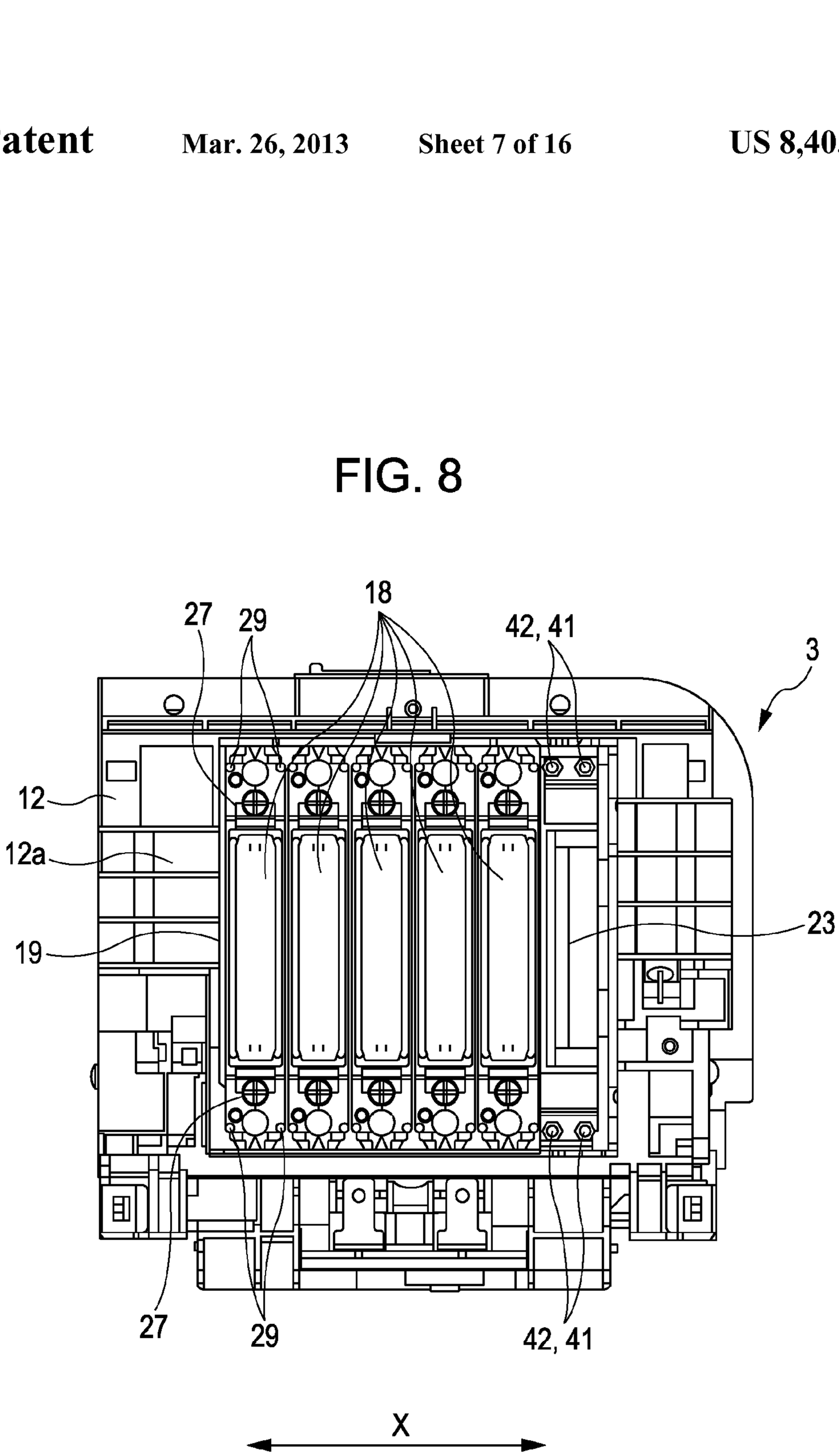

FIG. 9

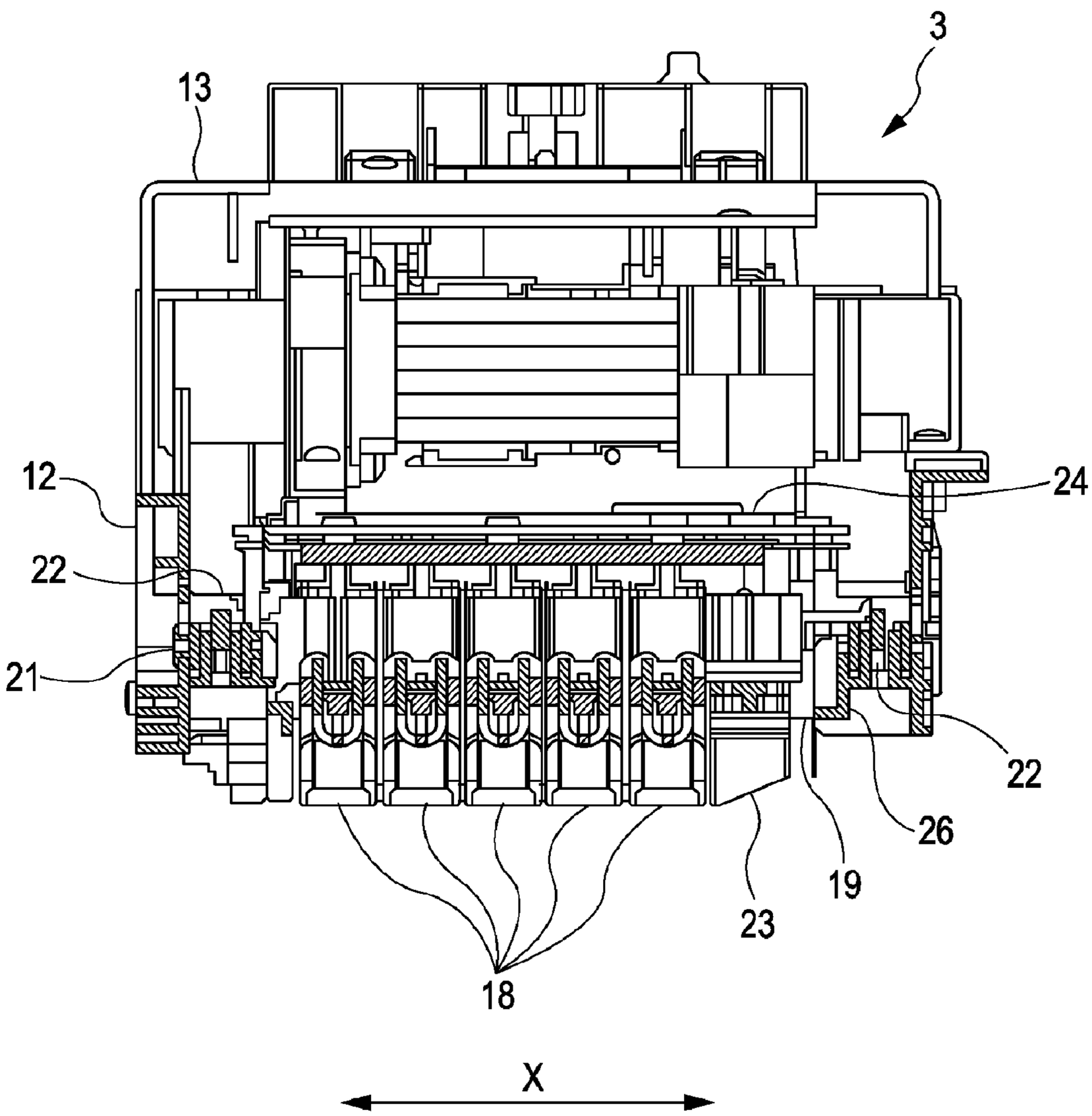

FIG. 10A

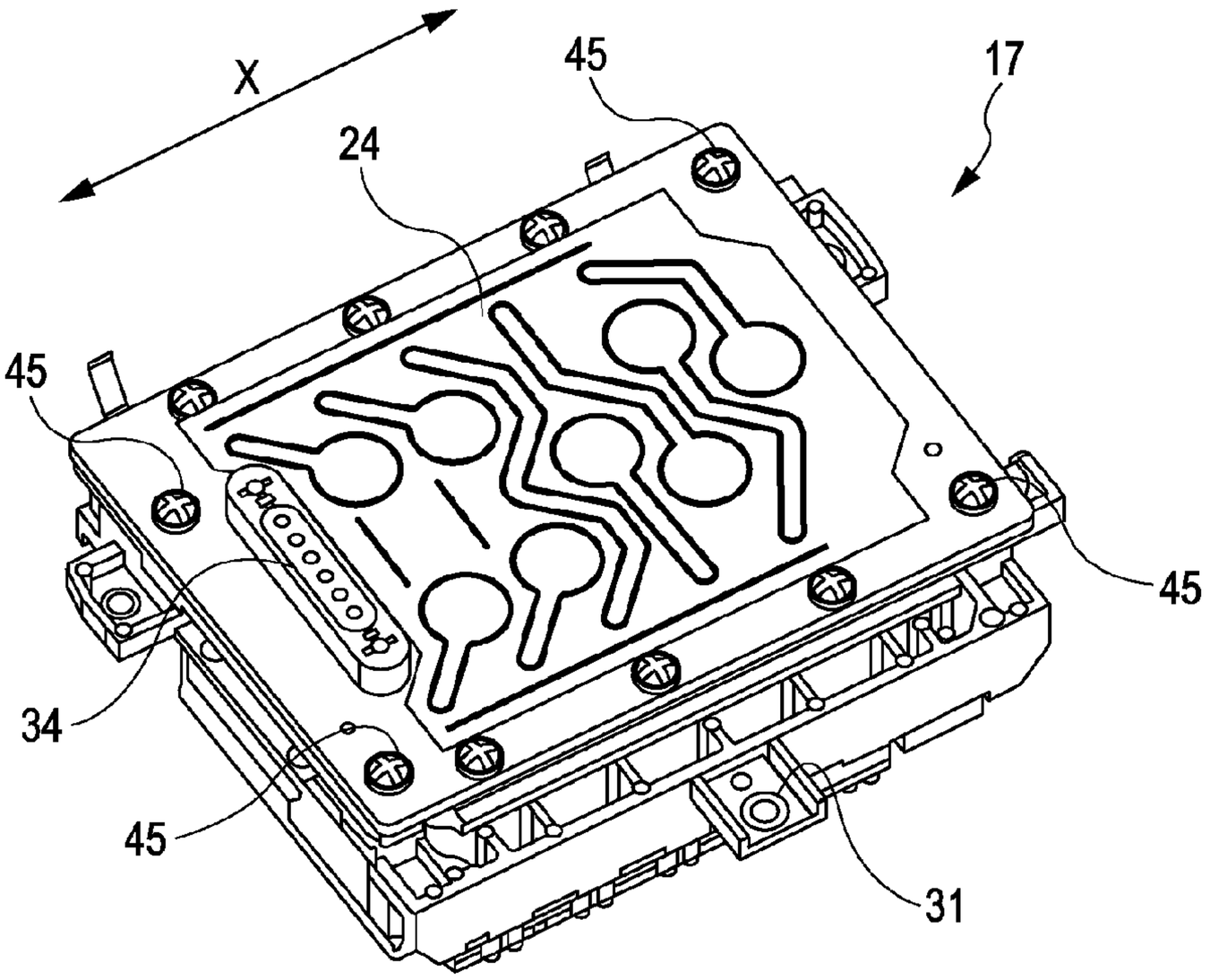

FIG. 10B

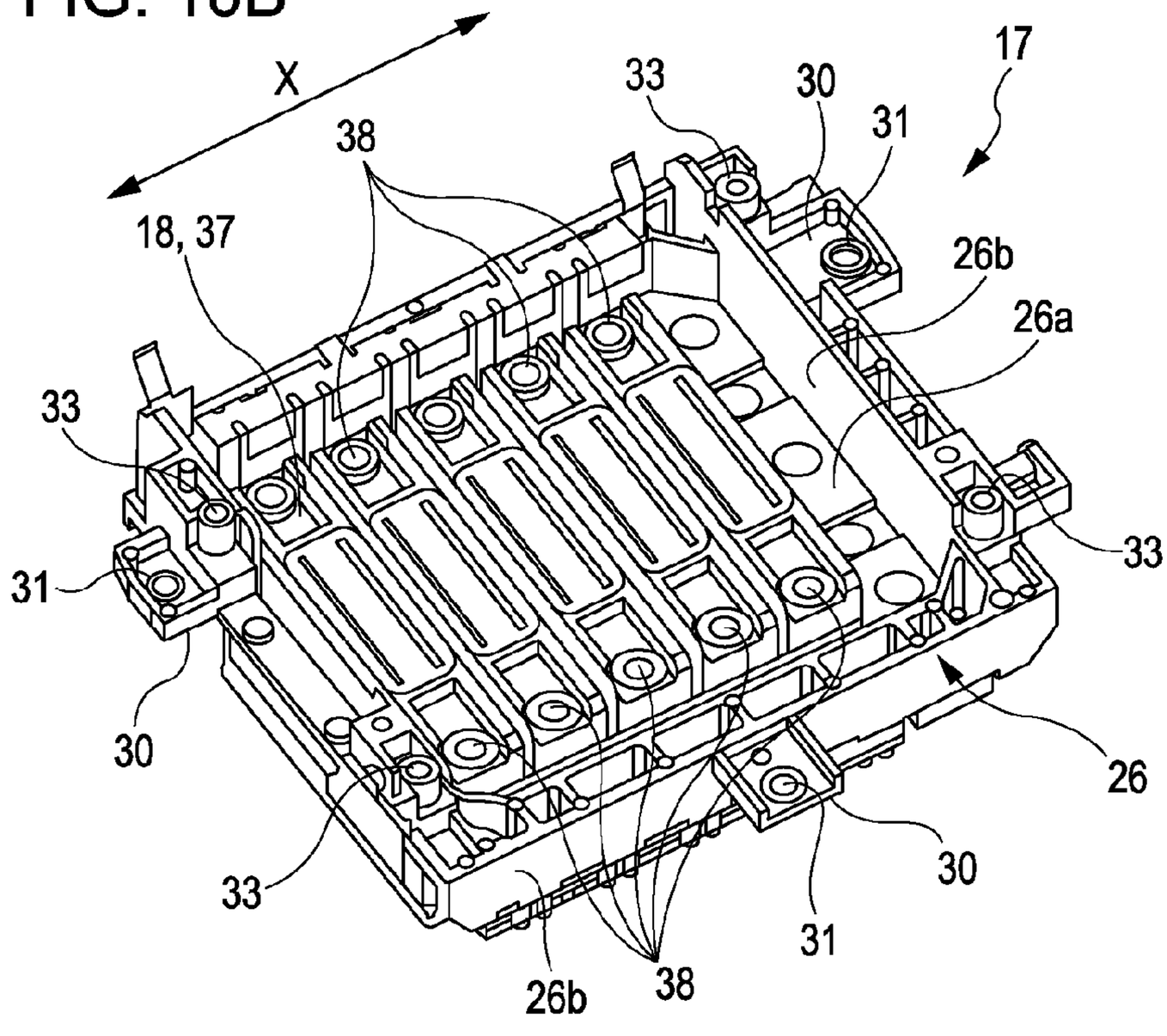

FIG. 11

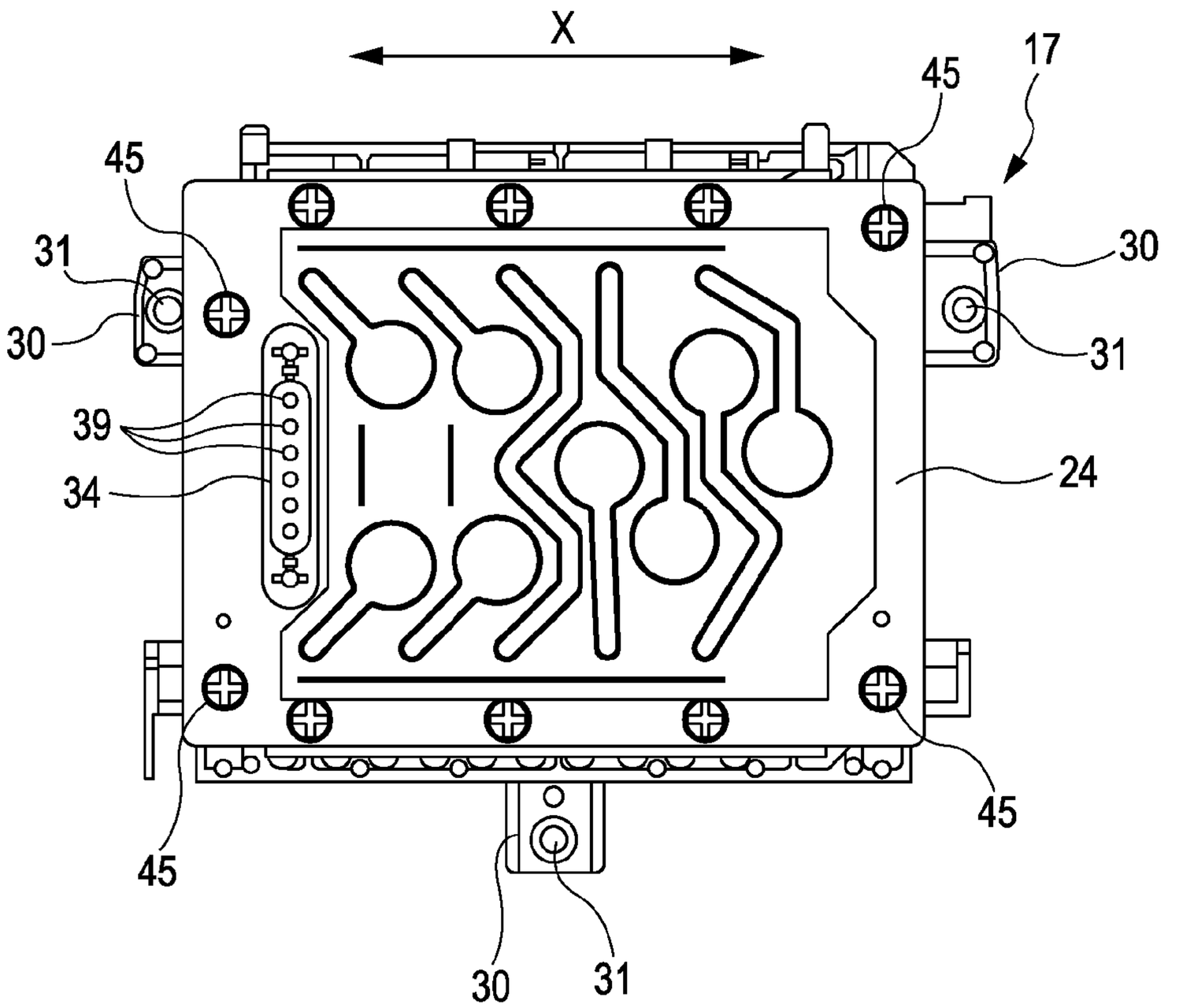
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FIG. 12

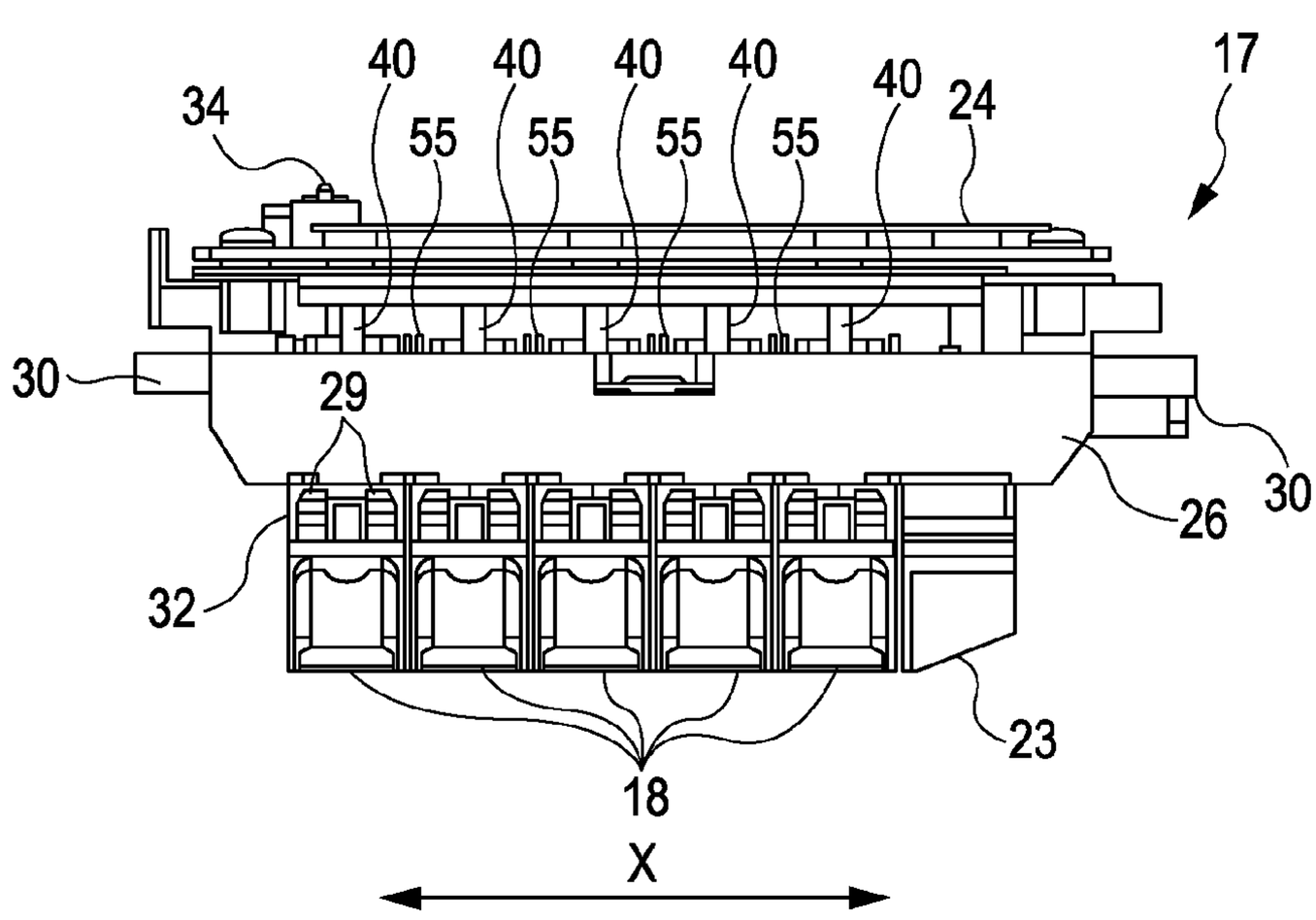
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FIG. 13

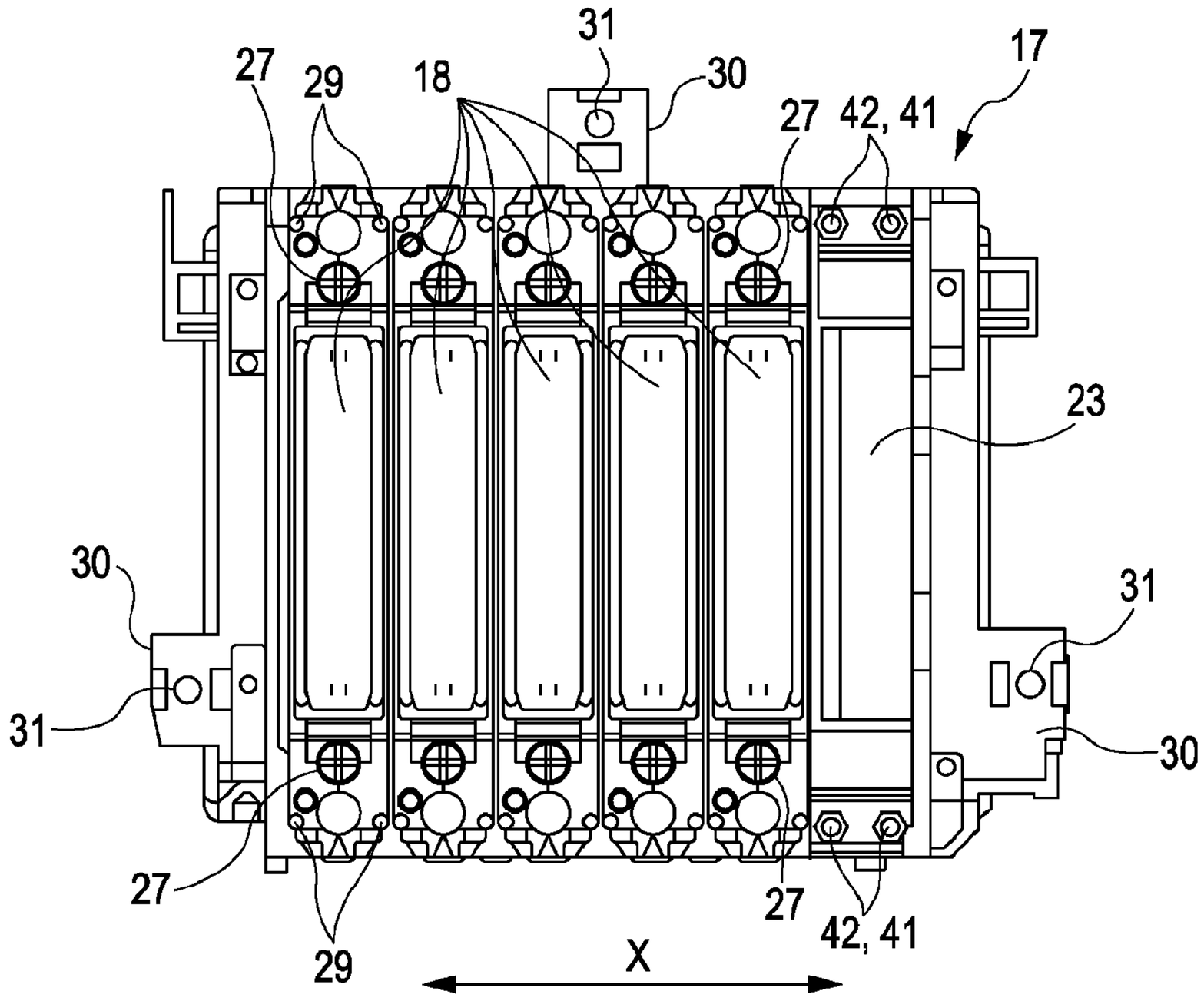
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FIG. 14

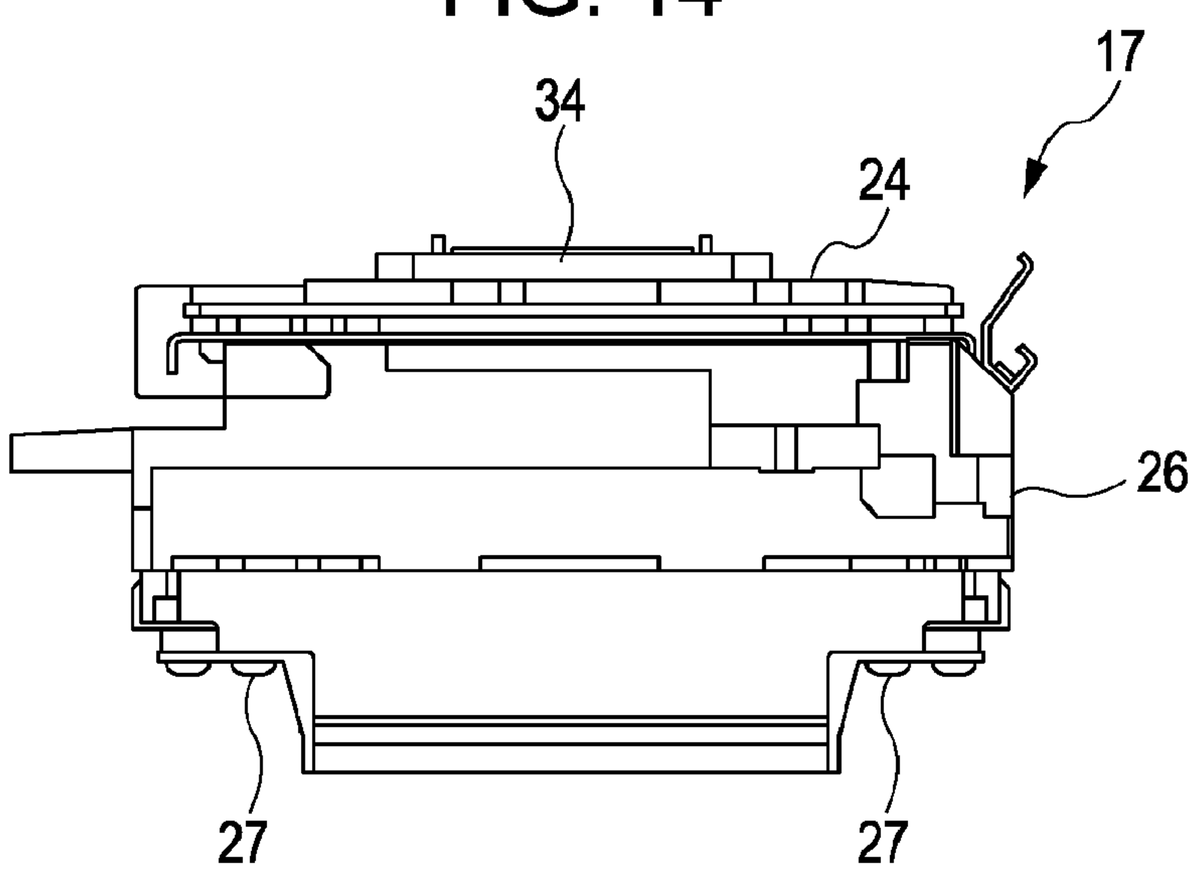
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FIG. 15

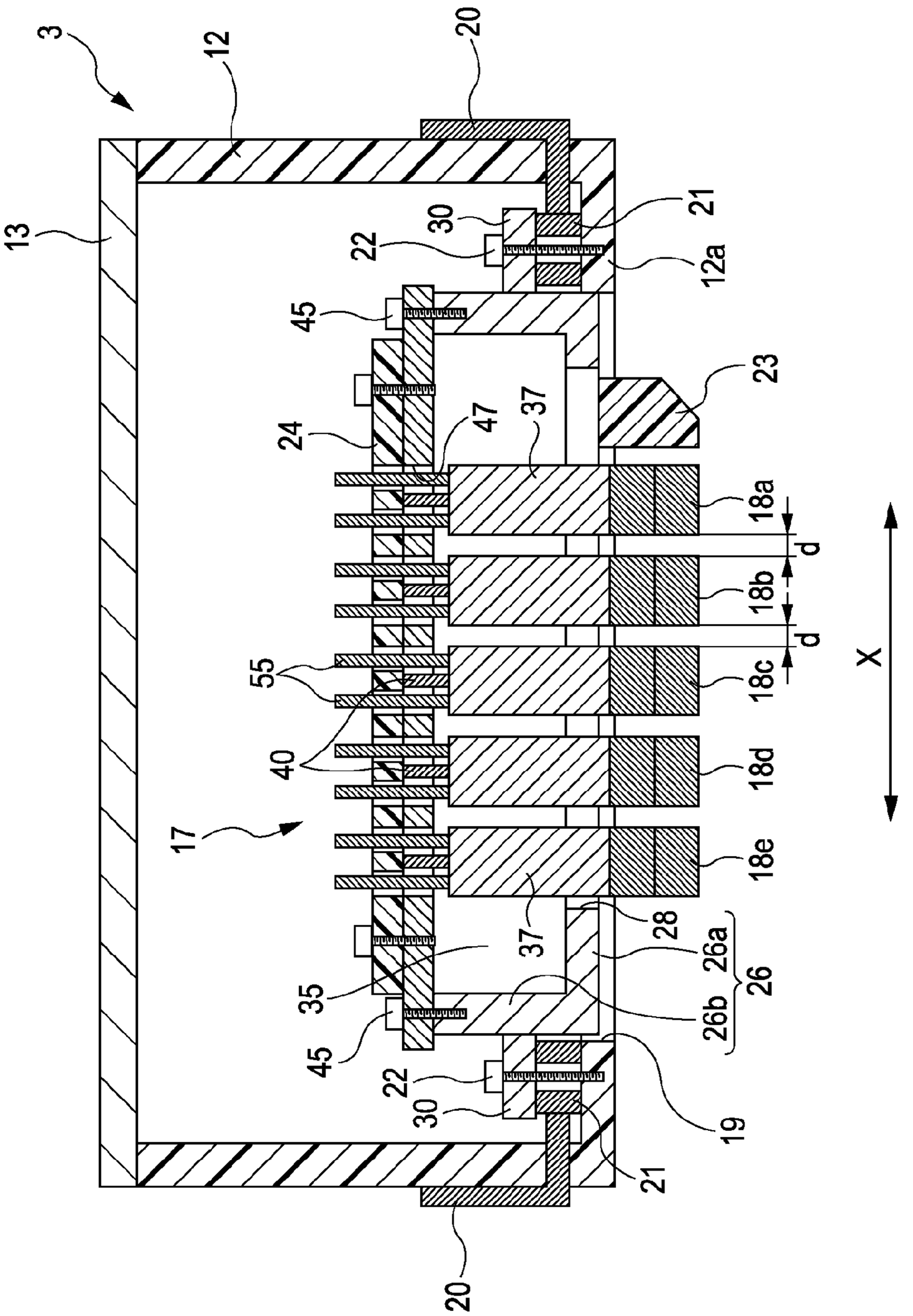
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FIG. 16

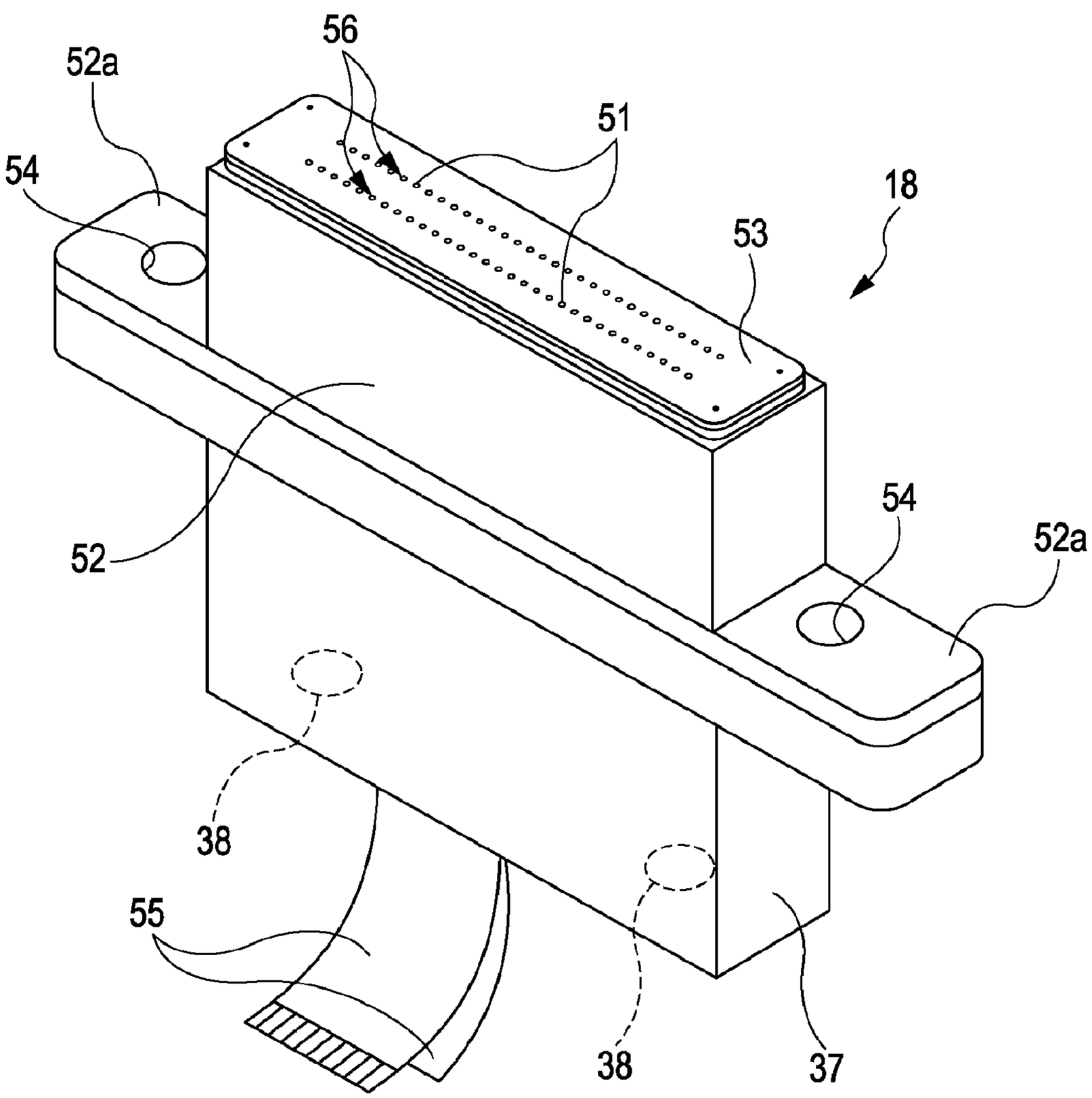


FIG. 17A

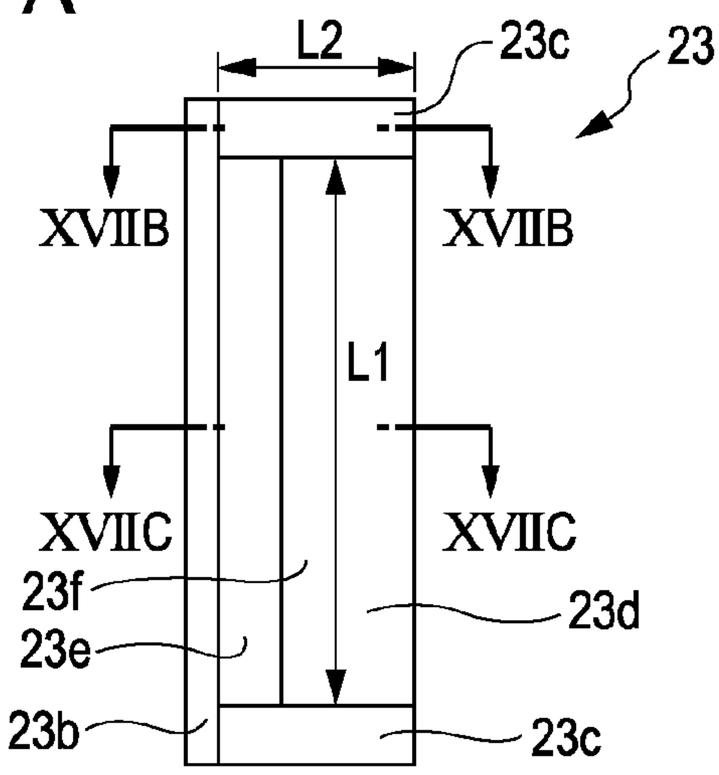


FIG. 17B

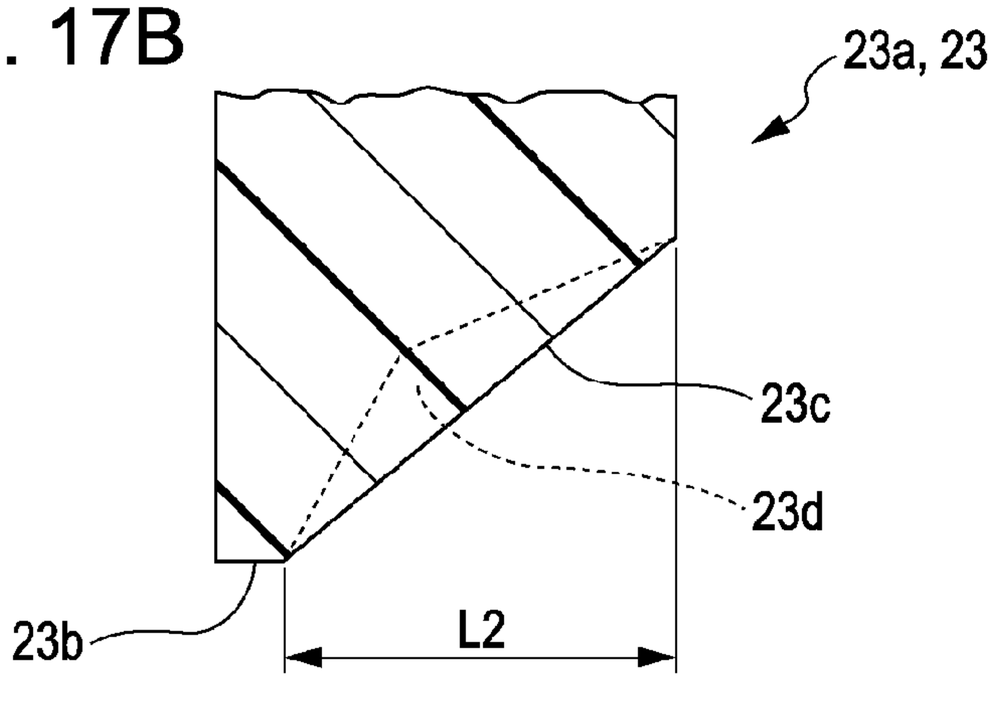


FIG. 17C

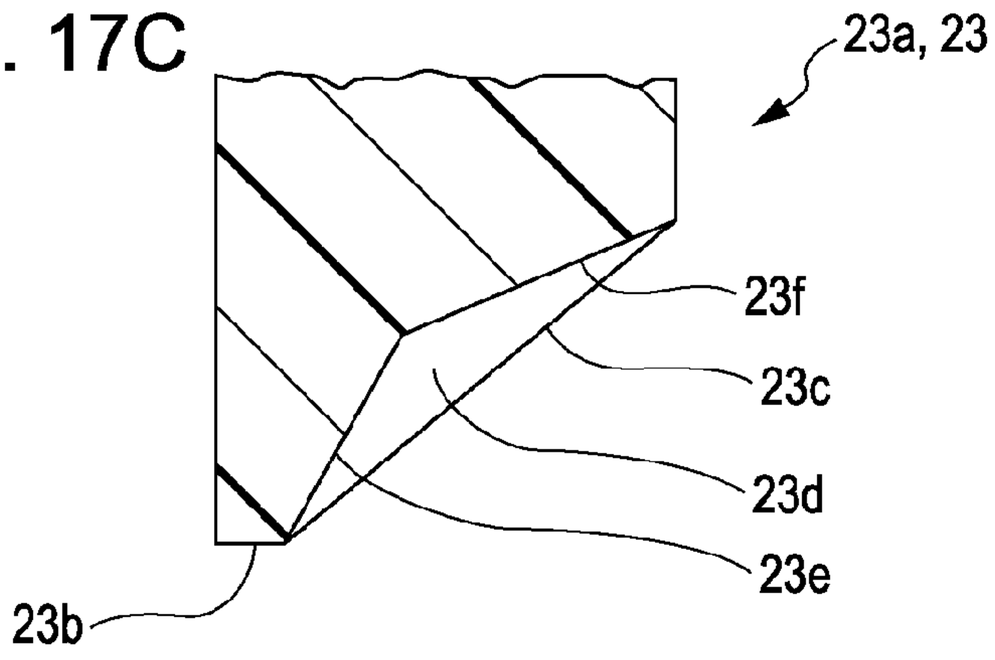
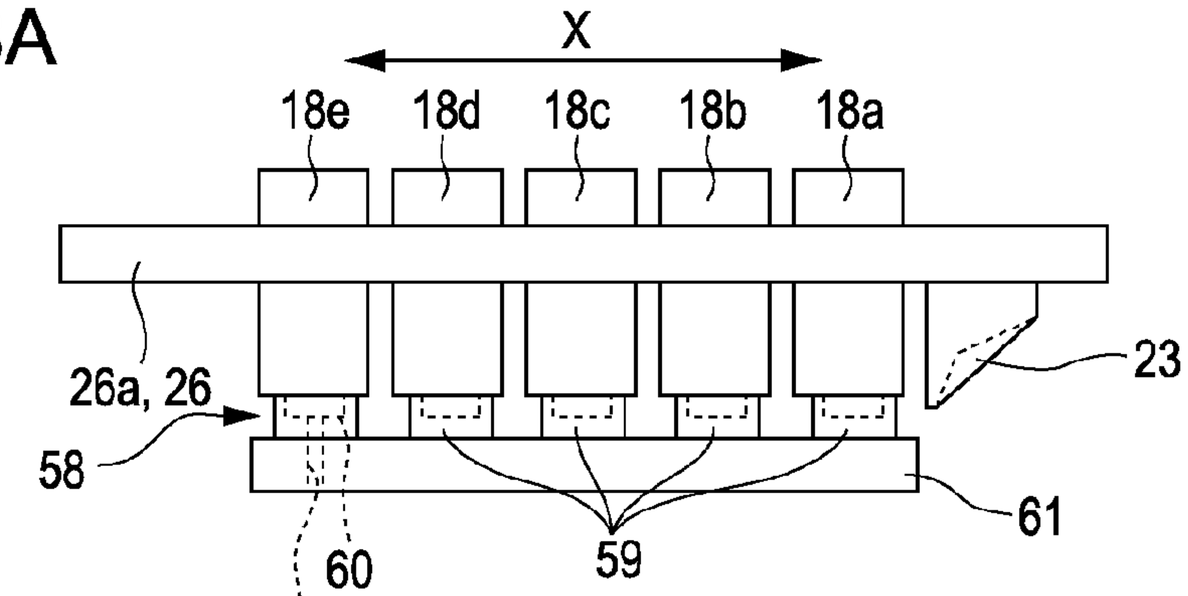


FIG. 18A



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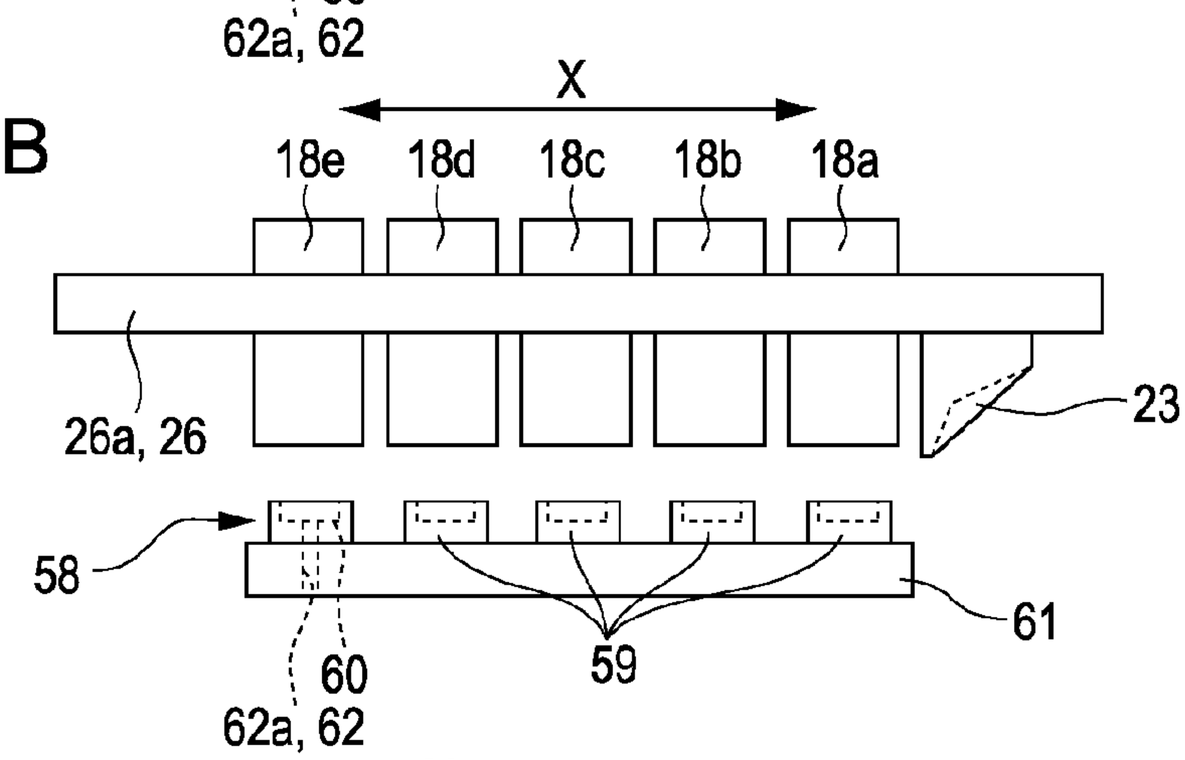

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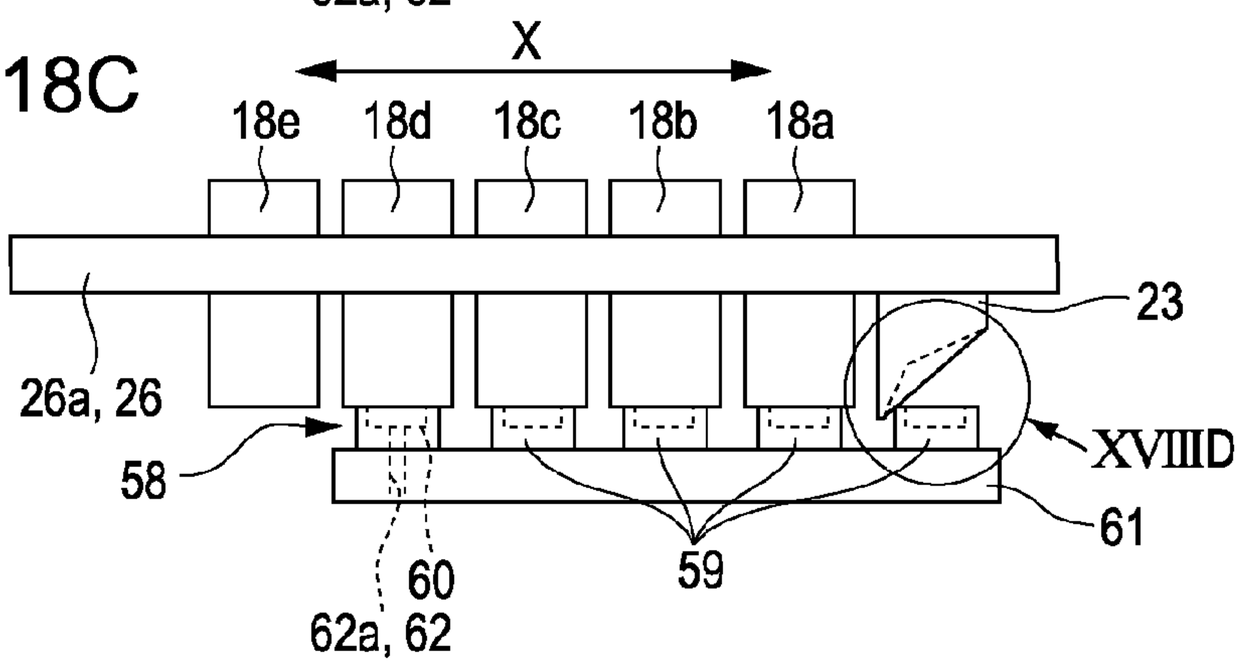

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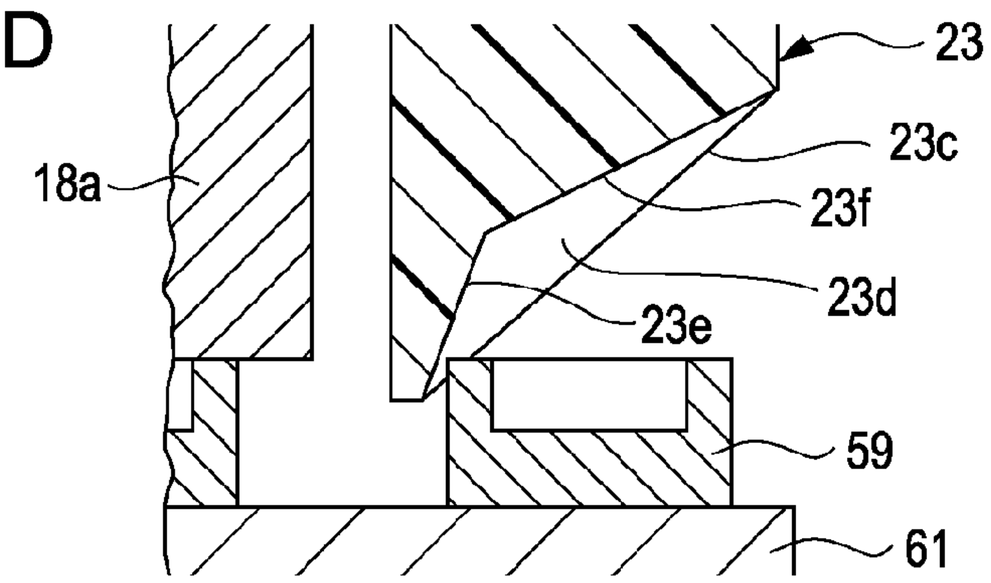
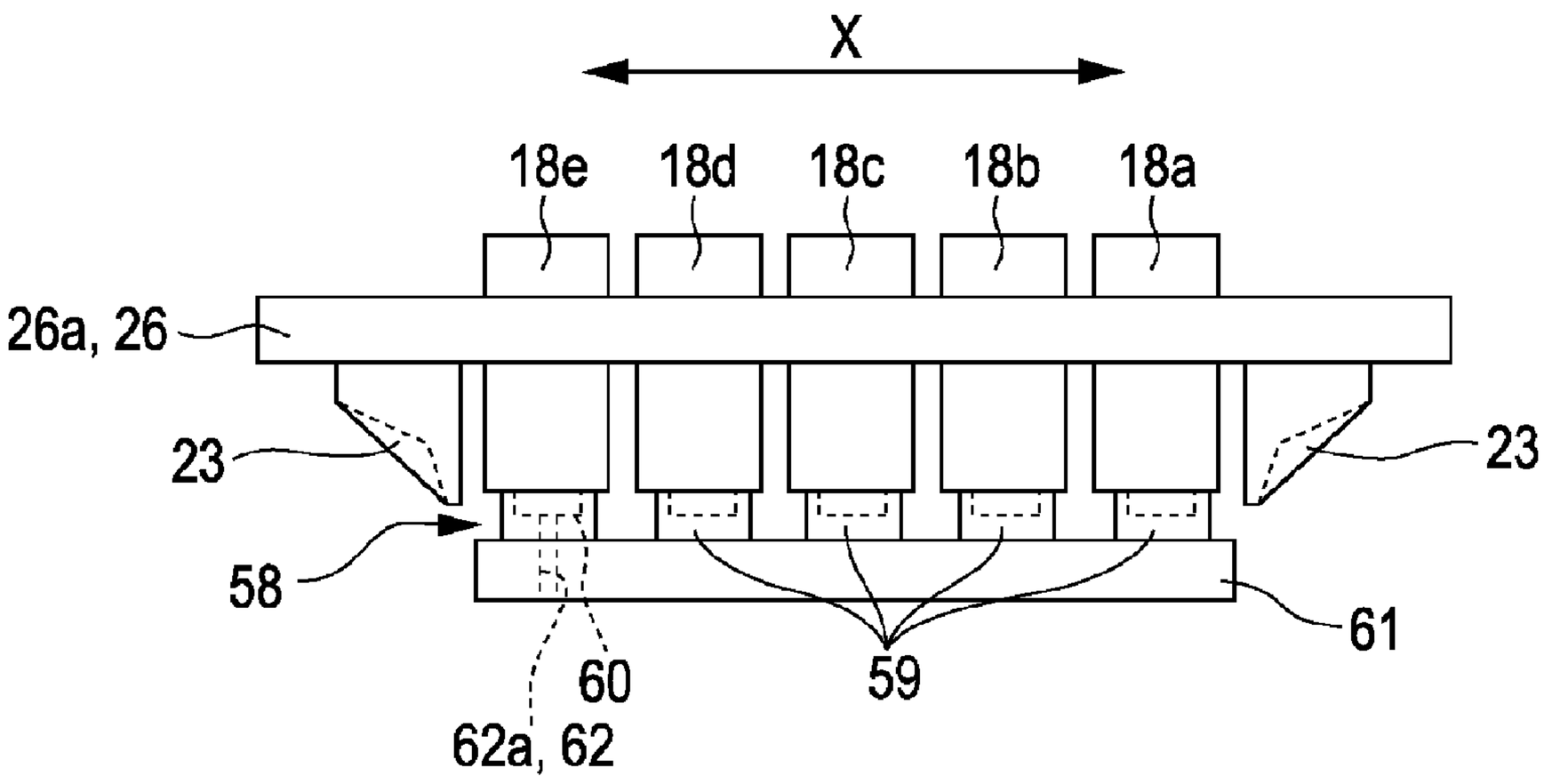


FIG. 19



LIQUID EJECTING APPARATUS

The entire disclosure of Japanese Patent Application No: 2010-159680, filed Jul. 14, 2010 and Japanese Patent Application No: 2010-197836, filed Sep. 3, 2010 are expressly incorporated by reference herein.

BACKGROUND

1. Technical Field

The present invention relates to a liquid ejecting apparatus that is equipped with a plurality of liquid ejecting heads for ejecting liquid retained in pressure chambers through nozzles by applying a pressure change in the pressure chambers, which are in communication with the nozzles.

2. Related Art

A liquid ejecting apparatus is a machine that is provided with a liquid ejecting head that can eject (discharge) liquid. Having such a liquid ejecting head, a liquid ejecting apparatus is capable of ejecting various kinds of liquid. An example of a liquid ejecting apparatus is an image recording apparatus such as an ink-jet printer. An ink-jet printer is provided with an ink-jet recording head, which is an example of various kinds of a liquid ejecting head. An ink-jet printer performs recording by ejecting ink in the form of ink droplets from nozzles of an ink-jet recording head toward a recording target medium such as a sheet of printing paper. As a result of the landing of discharged ink droplets on the surface of a recording target medium, dots are formed thereon. In this way, an ink-jet printer records an image and the like on a recording target medium. An ink-jet recording head is hereinafter simply referred to as a "recording head". An ink-jet printer is hereinafter simply referred to as a "printer". These days, the application of such a liquid ejecting apparatus is not limited to an image recording apparatus mentioned above. It is applied to various manufacturing apparatuses. For example, in a display manufacturing apparatus for the production of liquid crystal displays, plasma displays, organic electroluminescence (EL) displays, surface/plane emission displays (FED), or the like, a liquid ejecting apparatus is used as a machine for ejecting various liquid materials such as colorants and electrode materials onto a pixel formation area, an electrode formation area, and the like.

Some recent printers are equipped with a single head unit that has the following structure: a plurality of recording heads is fixed to a head-fixing member such as a sub carriage in a row; each of the plurality of recording heads has a nozzle group that is made up of a plurality of nozzles formed in rows. Some of them are equipped with a capping mechanism that includes a plurality of caps arranged in a row corresponding to the head row (for example, refer to JP-A-2008-273109). Each cap is, for example, is a tray-like member that is made of an elastic material such as elastomer. The top (facing the nozzle formation surface of the corresponding recording head) of the cap is open. When the printer is in a pause state in which a recording head is not used for printing an image and the like on a recording target medium or when operation for forcibly sucking ink, air bubbles, and the like out of the nozzles of a recording head is performed, the capping mechanism brings the top of sidewalls of a cap into contact with the nozzle formation surface of a recording head for sealing (capping). An inner space of the cap that is formed when the cap is in contact with the nozzle formation surface (hereinafter referred to as "sealed space") is in communication with a waste liquid tank through a waste liquid tube and a suction pump. The suction pump is driven to apply a negative pressure to the sealed space through the waste liquid tube. Due to the negative pressure, ink, air bubbles, and the like are discharged into the sealed space through nozzles. The ink, etc, discharged into the sealed space is drained to the waste liquid tank through the waste liquid tube.

A printer that has a protecting projection formed on a sub carriage has been proposed in the art. The protecting projection is provided for protecting a side and the nozzle formation surface of a recording head. The protecting projection is provided at an end in a direction in which a plurality of recording heads attached to a carriage is arranged in a row. The protecting projection protrudes downward, that is, toward a recording target medium during recording operation, in parallel with a side of a recording head. The front end of the protecting projection is located at the same height as the nozzle formation surface of each of the plurality of recording heads or below the surface. Since such a protecting projection is provided, it is possible to prevent recording paper or the like from coming into contact with a recording head when ink is ejected from the recording head onto the recording paper to print an image and the like thereon.

In such a printer, if each of a plurality of caps corresponding to a plurality of recording heads has a function for sucking ink, the structure of the printer is complex, which results in an increase in cost. To avoid an increase in cost, a printer that has a structure in which not all but some of caps corresponding to a plurality of recording heads have a function for sucking ink has now been being developed in the art. In such a structure, either the group of recording heads or the group of caps is moved relative to the other in a direction in which the recording heads are arranged in a row. By this means, a cap that has the ink-sucking function is brought into contact with a suction target head. With such a structure, it is possible to perform suction operation for all of the recording heads even though it is only some of the caps that have the ink-sucking function. However, such a printer has the following disadvantages. When capping operation is performed in a state in which any cap faces the protecting projection, the collision of the cap and the protecting projection sometimes occurs. In such a case, there is a risk of the sticking of ink from the cap onto the protecting projection. In addition, there is a risk of the dripping of the transferred ink from the protecting projection onto recording paper during printing.

SUMMARY

An advantage of some aspects of the invention is to provide a liquid ejecting apparatus that can protect a liquid ejecting head and makes it possible to shift a relative position of a cap group and liquid ejecting heads in parallel with respect to a direction in which the liquid ejecting heads are arranged in a row.

A liquid ejecting apparatus according to an aspect of the invention includes a liquid ejecting head unit, a protection member, and a cap group. The liquid ejecting head unit includes a head-fixing member to which a plurality of liquid ejecting heads is attached in a row. Each of the plurality of liquid ejecting heads has a nozzle surface and is capable of ejecting liquid toward a liquid ejection target medium from nozzles that are formed in the nozzle surface. The protection member is located outside the row of the liquid ejecting heads adjacent to a liquid ejecting head included in the liquid ejecting heads. This liquid ejecting head is located at an end in a direction in which the liquid ejecting heads are arranged in the row, the direction being hereinafter referred to as side-by-side-arrangement direction. The protection member is provided thereat for protecting a side of the adjacent liquid ejecting head. The cap group is made up of a plurality of caps for

covering the nozzles. The number of the caps is the same as that of the liquid ejecting heads of the liquid ejecting head unit. The caps are arranged in the side-by-side-arrangement direction with the same gap each therebetween as the gap of the liquid ejecting heads each therebetween. A relative position of the cap group and the liquid ejecting heads of the liquid ejecting head unit can be shifted in parallel with respect to the side-by-side-arrangement direction. A state of the cap group can be changed into a state in which a cap included in the cap group is in contact with the nozzle surface. The protection member has an inclined plane at a front-end portion. The inclined plane is sloped up from a liquid-ejecting-head side toward the opposite side, that is, outward, with respect to the side-by-side-arrangement direction. A recess is formed at a part of the inclined plane. In a state in which one of the caps faces the protection member and, in addition, each of the remaining caps is in contact with the nozzle surface of a liquid ejecting head, a part of the cap facing the protection member is in the recess, which ensures that the cap is not in contact with the protection member.

With such a structure, when the apparatus is put into a state in which one of the caps faces the protection member and, in addition, each of the remaining caps is in contact with the nozzle surface of a liquid ejecting head, a part of the cap facing the protection member is allowed to escape into the recess in a contact-avoiding manner. Thus, the collision/contact of the cap with the protection member does not occur. Thus, the sticking of liquid from the cap onto the protection member does not occur. Moreover, since the protection member has the inclined plane, when a liquid ejection target medium that is transported toward the liquid ejecting head unit from a side in the side-by-side-arrangement direction collides with the inclined plane, the protection member can guide the liquid ejection target medium away from the head-fixing member along its inclined plane, thereby lessening the impact of the collision. That is, in addition to its structure for avoiding contact with a cap at the time of capping operation, the protection member has a function of protecting the liquid ejecting head. Since the protection member has a contact-avoiding function, a structure in which a sucking means is provided in at least one cap in the cap group and suction operation is performed for all of the liquid ejecting heads attached to the head-fixing member sequentially through the relative movement of the liquid ejecting heads and the cap group can be adopted. That is, it is not necessary to provide the sucking means as an individual sucking device for each of caps making up the cap group, thereby offering a simplified structure.

In the above structure, it is preferable that the recess should include a first recess inclined plane that is steeper than the inclined plane with respect to a plane that is parallel with the nozzle surface and a second recess inclined plane that is gentler than the inclined plane with respect to the plane that is parallel with the nozzle surface.

With such a preferred structure, even when a liquid ejection target medium gets into the recess, the protection member can exert its function of guiding the liquid ejection target medium downward. More specifically, the protection member can guide the liquid ejection target medium downward along the second recess inclined plane and the first recess inclined plane. Therefore, it is possible to lessen the impact of collision that occurs when the liquid ejection target medium gets into the recess.

Preferably, a liquid ejecting apparatus according to the above aspect of the invention should further include a sucking section, wherein at least one of the plurality of caps that make up the cap group can suck liquid out of the nozzles formed in the nozzle surface by using a suction force of the sucking section in a state in which the at least one cap is in contact with the nozzle surface.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described with reference to the accompanying drawings, wherein like numbers reference like elements.

FIG. **1** is a perspective view that schematically illustrates an example of a part of the inner structure of a printer according to an exemplary embodiment of the invention.

FIG. **2** is a front view of the printer.

FIG. **3** is a plan view of the printer.

FIG. **4** is a right side view of the printer.

FIG. **5** is a plan view of a carriage assembly according to an exemplary embodiment of the invention.

FIG. **6** is a front view of the carriage assembly.

FIG. **7** is a right side view of the carriage assembly.

FIG. **8** is a bottom view of the carriage assembly.

FIG. **9** is a sectional view taken along the line IX-IX of FIG. **5**.

FIG. **10**A is a perspective view of a head unit according to an exemplary embodiment of the invention.

FIG. **10**B is a perspective view of the head unit.

FIG. **11** is a plan view of the head unit.

FIG. **12** is a front view of the head unit.

FIG. **13** is a bottom view of the head unit.

FIG. **14** is a right side view of the head unit.

FIG. **15** is a sectional view that illustrates the structure of the carriage assembly in a more simplified way.

FIG. **16** is a perspective view of a recording head according to an exemplary embodiment of the invention.

FIG. **17**A is a bottom view of a head protection member according to an exemplary embodiment of the invention.

FIG. **17**B is a close-up sectional view taken along the line XVIIB-XVIIB of FIG. **17**A.

FIG. **17**C is a close-up sectional view taken along the line XVIIC-XVIIC of FIG. **17**A.

FIG. **18**A is a side view of the head unit and a cap group according to an exemplary embodiment of the invention; specifically, a state in which the cap group is in contact with each recording head is illustrated therein.

FIG. **18**B is a side view of the head unit and the cap group; specifically, a state in which the cap group is not in contact with each recording head is illustrated therein.

FIG. **18**C is a side view of the head unit and the cap group; specifically, a state in which the cap group is in contact with the recording heads after movement in a horizontal direction is illustrated therein.

FIG. **18**D is a close-up sectional view of the head unit and the cap group; specifically, a part XVIIID is illustrated therein in an enlarged view.

FIG. **19** is a side view of a head unit and a cap group according to another embodiment of the invention.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

With reference to the accompanying drawings, exemplary embodiments of the present invention will now be explained in detail. Although various specific features are explained in the following exemplary embodiments of the invention for the purpose of disclosing preferred modes thereof, the scope of the invention is not limited to the specific embodiments described below unless any intention of restriction is explicitly shown. In the following description, an ink-jet recording

apparatus is taken as an example of a liquid ejecting apparatus according to an aspect of the invention. The ink-jet recording apparatus is hereinafter simply referred to as a "printer".

FIG. **1** is a perspective view that schematically illustrates an example of a part of the inner structure of a printer **1**. FIG. **2** is a front view of the printer **1**. FIG. **3** is a plan view of the printer **1**. FIG. **4** is a right side view of the printer **1**. The printer **1** illustrated in these drawings ejects ink, which is a kind of liquid, toward a recording target medium such as a sheet of recording paper, cloth, film, or the like (not shown). The recording target medium is a kind of a liquid ejection target medium according to an aspect of the invention, which is, for example, an object on which ink droplets discharged from a print head will land. The printer **1** has a frame **2**. A carriage assembly **3**, which is a kind of a head-unit holding member, is provided inside the frame **2**. The carriage assembly **3** can reciprocate in a main scan direction, which is orthogonal to a direction in which a recording target medium is transported. The main scan direction is denoted as X in the accompanying drawings including FIG. **1**. A pair of elongated upper and lower guide rods **4***a* and **4***b* is supported along the inside of the rear wall of the frame **2** of the printer **1** in the direction of the length of the frame **2**. The guide rods **4***a* and **4***b* are supported in parallel with each other with a predetermined clearance therebetween. The guide rod **4** is inserted through a bearing cavity **7** (refer to FIG. **7**), etc., which is formed at the back of the carriage assembly **3**. With such a structure, the carriage assembly **3** can slide along the guide rod **4** in a supported state.

A carriage motor **8** is provided at the rear of the frame **2** at one end in the main scan direction X (right end in FIG. **3**). The carriage motor **8** is a driving source that supplies power to move the carriage assembly **3**. The driving shaft of the carriage motor **8** protrudes inward from the rear side of the frame **2**. A driving pulley, which is not illustrated in the drawings, is provided at the tip of the shaft. The driving pulley rotates when driven by the carriage motor **8**. A driven pulley, which is not illustrated in the drawings, is provided at the side opposite to the side of the driving pulley in the main scan direction X (left end in FIG. **3**). A timing belt **9** is stretched between the driving pulley and the driven pulley. The carriage assembly **3** is attached to the timing belt **9**. When the carriage motor **8** operates, the driving pulley rotates. The timing belt **9** turns due to the rotation of the driving pulley. As a result, the carriage assembly **3** moves along the guide rods **4***a* and **4***b* in the main scan direction X.

A linear scale (encoder film) **10** is provided on the inside of the rear wall of the frame **2** in parallel with the guide rods **4***a* and **4***b* along the main scan direction X. The linear scale **10** is a strip-shaped (band-like) member that is made of a transparent resin film. For example, the linear scale **10** has the following structure. A plurality of stripes that is not transparent is printed on the surface of a transparent base film. Each of the plurality of stripes extends in the direction of the width of the strip. The stripes have equal width. The stripes are printed at a constant pitch in the direction of the length of the strip. On the other hand, a linear encoder (not shown) is provided on the rear of the carriage assembly **3**. The linear encoder optically reads the stripes of the linear scale **10**. For example, the linear encoder is made up of a pair of a light-emitting element and a light-receiving element that are arranged opposite to each other. The linear encoder outputs an encoder pulse depending on a difference between the state of photo detection at each transparent part of the linear scale **10** and the state of photo detection at each stripe part thereof. That is, the linear encoder is a kind of a positional information outputting means. Functioning as such a means, the linear encoder outputs an encoder pulse corresponding to the scan position of the carriage assembly **3** as positional information in the main scan direction X. Therefore, the control unit (not shown) of the printer **1** can control the recording operation of a head unit **17** on a recording target medium while obtaining information on the scan position of the carriage assembly **3** on the basis of an encoder pulse supplied from the linear encoder. The printer **1** is configured to be able to perform so-called bidirectional recording processing. Specifically, the printer **1** can print characters, images, and the like on a sheet of recording paper both during the outward movement of the carriage assembly **3** and the homeward movement thereof. During its outward movement, the carriage assembly **3** travels from a home position, which is located at one end in the main scan direction X, to a full position, which is located at the other end in the main scan direction X. The home position is a position where the carriage assembly **3** is in a stationary state on standby when it is not being driven. During its homeward movement, the carriage assembly **3** travels from the full position back to the home position.

As illustrated in FIG. **3**, an ink-supplying tube **14** and a signal cable **15** are connected to the carriage assembly **3**. Ink having each of a plurality of colors is supplied through the ink-supplying tube **14** to the corresponding one of a plurality of recording heads **18** of the head unit **17**. Signals such as a driving signal are supplied through the signal cable **15**. A plurality of capping members each of which can seal the nozzle formation surface **53** of the recording head **18** is provided below the carriage assembly **3**, more specifically, under the carriage assembly **3** when it is in a standby state at the home position. A more detailed explanation of the plurality of capping members will be given later. In addition to the components explained above, though not illustrated in the drawings, the printer **1** includes a cartridge attachment portion, to which ink cartridges (source for supplying liquid) containing ink can be detachably attached, a medium transportation unit, which transports recording paper, and the like.

FIG. **5** is a plan view (top view) of the carriage assembly **3**. FIG. **6** is a front view of the carriage assembly **3**. FIG. **7** is a right side view of the carriage assembly **3**. FIG. **8** is a bottom view of the carriage assembly **3**. FIG. **9** is a sectional view taken along the line IX-IX of FIG. **5**. Note that a state after the removal of a carriage cover **13** is illustrated in FIG. **5**. The carriage assembly **3** is a hollow box-like member that is made up of two components, which are a carriage body **12** and the carriage cover **13**, and can be separated into the lower component and the upper component. The head unit **17** is mounted inside the carriage body **12**. The carriage body **12** has an opening at its top, which is usually covered by the carriage cover **13**. A more detailed explanation of the head unit **17**, which is an example of a liquid ejecting head unit according to an aspect of the invention, will be given later. The carriage body **12** includes a substantially rectangular bottom plate portion **12***a* and sidewall portions **12***b*. Each of the sidewall portions **12***b* rises perpendicularly from the corresponding one of the four sides of the bottom plate portion **12***a*. The head unit **17** is housed in a space enclosed by the bottom plate portion **12***a* and the sidewall portions **12***b*. As illustrated in FIG. **8**, a bottom opening **19** is formed in the bottom plate portion **12***a* for the purpose of exposing the nozzle formation surface **53** (refer to FIG. **16**) of each of the plurality of recording heads **18** of the head unit **17** housed in the space. In a state in which the head unit **17** is mounted inside the carriage body **12**, each of the plurality of recording heads **18** protrudes partially through the bottom opening **19** of the bottom plate portion **12***a* in such a manner that its nozzle formation surface **53** is located under the bottom of the car-

riage body **12**, in other words, protrudes toward (is located closer to) a recording target medium during recording operation.

A plurality of eccentric cams **21** (refer to FIGS. **9** and **15**) is provided between the carriage body **12** and the head unit **17**. The eccentric cams **21** are used for adjusting the relative position/inclination (hereinafter referred to as "mount state") of the head unit **17** mounted inside the carriage body **12**. A plurality of levers **20** that is used for rotating these eccentric cams **21** is provided on the carriage body **12**. The plurality of eccentric cams **21** rotates when these levers **20** are operated. When the eccentric cam **21** rotates, its height from the center of rotation to its circumferential surface fluctuates. It is possible to adjust the mount state of the head unit **17** housed in the space of the carriage body **12**, such as the position of the head unit **17** and the inclination thereof, in relation to the carriage body **12** by utilizing the increase/decrease in the height of each of the plurality of eccentric cams **21**.

FIG. **10**A is a perspective view of the head unit **17**. Specifically, FIG. **10**A illustrates a state in which a flow passage member **24** is attached as a part of the head unit **17**. FIG. **10**B is also a perspective view of the head unit **17**. A state in which the flow passage member **24** has been detached therefrom is illustrated in FIG. **10**B. FIG. **11** is a plan view (top view) of the head unit **17**. FIG. **12** is a front view of the head unit **17**. FIG. **13** is a bottom view of the head unit **17**. FIG. **14** is a right side view of the head unit **17**. FIG. **15** is a sectional view that illustrates the structure of the carriage assembly **3** in a more simplified way in order to facilitate the understanding of the present embodiment of the invention. Since FIG. **15** is a simplified diagram of the structure of the carriage assembly **3**, the shape of each member, component, and the like and positional relationships therebetween in the illustration could be different from actual embodiments.

The head unit **17** is configured as an integrated unit of the plurality of recording heads **18** and the like. The head unit **17** includes a sub carriage **26** and the flow passage member **24**. The sub carriage **26**, which is an example of a head-fixing member according to an aspect of the invention, is a member to which the recording heads **18** are attached in a row, that is, next to one another. The sub carriage **26** is a hollow open-topped box-like member. Specifically, the sub carriage **26** includes a base plate portion **26***a* and sidewall portions **26***b*. The plurality of recording heads **18** is attached to the base plate portion **26***a*. Each of the sidewall portions **26***b* rises perpendicularly from the corresponding one of the four sides of the base plate portion **26***a*. A space that is enclosed by the base plate portion **26***a* and the sidewall portions **26***b* serves as a housing space **35** (refer to FIG. **15**), which is a space in which at least a part of each of the plurality of recording heads **18** (mainly a sub tank **37**) is housed. The sub carriage **26** according to the present embodiment of the invention is made of metal such as aluminum and thus has high rigidity. A head insertion opening **28** through which the plurality of recording heads **18** can be inserted (that is, a single opening that is shared by the plurality of recording heads **18**) is formed at substantially the center of the base plate portion **26***a*. Therefore, the base plate portion **26***a* has a frame-like body. A plurality of fixing holes (female screws) **29** is formed in the lower surface (which is a surface that faces a recording target medium during recording operation) of the base plate portion **26***a* at positions corresponding to the attachment area of each of the plurality of recording heads **18** (refer to FIG. **12**). Specifically, in the present embodiment of the invention, two fixing holes **29** are formed at each of two sides as viewed in a direction corresponding to the direction of a nozzle line at positions corresponding to the attachment holes of a spacer **32** for the attachment area of each of the plurality of recording heads **18** with the head insertion opening **28** formed between the two sides. In other words, the plurality of (i.e., four) fixing holes **29** is formed at four places respectively for the attachment area of each of the plurality of recording heads **18** (i.e., four female screws in total for one attachment area). The structure of each fixing hole **29** (i.e., the diameter of the screw hole, the depth thereof, and the thread pitch thereof) is the same as that of each fixing hole **41**, which will be explained later, for common mechanical design.

The spacer **32** is a member that is made of synthetic resin. One spacer **32** is provided on the upper surface (which is a surface that is closer to the sub tank **37**) of a flange portion **52***a* (refer to FIG. **16**) at each of two sides for each of the plurality of recording heads **18**. That is, two spacers **32** are provided for each of the plurality of recording heads **18**. A head insertion hole (not shown) is formed at the center of the spacer **32** in its width direction, that is, in a direction orthogonal to the direction of a nozzle line. The head insertion hole corresponds to a spacer attachment hole **54** of the recording head **18**. An attachment hole (not shown) is formed at each of two sides in the width direction of the spacer **32**. The attachment hole corresponds to the fixing hole **29**, which is formed in the sub carriage **26**. That is, one head insertion hole and two attachment holes are formed in each of the plurality of spacers **32**. In an assembly process before the attachment of the plurality of recording heads **18** to the sub carriage **26**, the spacer **32** is screwed to the flange portion **52***a* at each of two sides of each of the plurality of recording heads **18**. A spacer-fixing screw **27** is used for fixing the spacer **32** thereto.

As illustrated in, for example, FIG. **10**, a flange portion **30** is formed on each of three of the (four) sidewall portions **26***b* of the sub carriage **26**. The flange portions **30** extend sideward. An insertion hole **31** is formed through each of the three flange portions **30**. The three insertion holes **31** correspond to threaded holes for attachment (not shown) that are formed at three places respectively at the position of the attachment of the head unit **17** to the bottom plate portion **12***a* of the carriage body **12**. After the position alignment of each of the three insertion holes **31** with the corresponding one of the three attachment screw holes of the bottom plate portion **12***a* of the carriage body **12**, a head-unit-fixing screw **22** is driven (screwed) into each of the three attachment screw holes through the corresponding one of the three insertion holes **31**. In this way, the head unit **17** is fixed to the carriage body **12** in a state in which the head unit **17** is housed in the inner space of the carriage body **12**. As explained earlier, in a manufacturing process before the non-provisional fixing of the head unit **17** to the carriage body **12**, the plurality of levers **20** described earlier is operated so as to adjust the mount state of the head unit **17** housed in the space of the carriage body **12**, such as the position of the head unit **17** and the inclination thereof, in relation to the carriage body **12**. Screw holes **33** for fixing the flow passage member **24** are formed at four places in the upper surface of the sidewall portions **26***b* of the sub carriage **26**.

The flow passage member **24** is a low-profile box-like member. For example, the flow passage member **24** is made of synthetic resin. A plurality of ink distribution flow passages (not shown) is formed inside the flow passage member **24** with a partition wall formed each therebetween. Each of the plurality of ink distribution flow passages corresponds to an ink color. In addition, each of the plurality of ink distribution flow passages corresponds to a flow passage connection portion (portions) **38** of the sub tank **37** (which will be described later) of the recording head **18**. A tube connection portion **34** is formed on the upper surface of the flow passage member

24. As illustrated in FIG. **11**, a plurality of inlet ports **39** each of which corresponds to an ink color is formed inside the tube connection portion **34**. Each of the plurality of inlet ports **39** is in communication with the ink distribution flow passage of the corresponding ink color. The ink-supplying tube **14** described earlier has an inner ink-supplying passage for each ink color. When the ink-supplying tube **14** is connected to the tube connection portion **34**, the ink-supplying passage for each ink color becomes in communication with the corresponding inlet port **39** in a liquid-tight state. As a result, ink of each color, which has been supplied from the ink-cartridge side through the ink-supplying tube **14**, flows into the corresponding ink distribution flow passage in the flow passage member **24** through the corresponding inlet port **39**. Flow-passage insertion holes (not shown) are formed at four corners of the flow passage member **24**. The flow-passage insertion holes correspond to the screw holes **33** of the sub carriage **26**. Each of the flow-passage insertion holes is a through hole that goes in the direction of plate thickness. To fix the flow passage member **24** to the sub carriage **26**, a flow-passage-member-fixing screw **45** is driven (screwed) into each of the plurality of screw holes **33** through the corresponding flow-passage insertion hole.

As illustrated in FIGS. **12** and **15**, a connection flow passage member **40**, which extends downward, is provided on the lower surface of the flow passage member **24** at a position corresponding to the flow passage connection portion **38** of the sub tank **37** of each of the plurality of recording heads **18**. Each of the plurality of connection flow passage members **40** is a hollow cylindrical member that has an inner outlet passage (not shown) with which the ink distribution flow passage of the corresponding ink color is in communication. The connection flow passage member **40** is inserted in the flow passage connection portion **38** of the sub tank **37** of each of the plurality of recording heads **18** for liquid-tight connection. Having flowed through the ink distribution flow passage in the flow passage member **24**, ink is supplied to the sub tank **37** of the recording head **18** through the connection flow passage member **40** and the flow passage connection portion **38**. In other words, the ink-supplying tube **14** is indirectly connected to the sub tanks **37** through the flow passage member **24**, which is provided therebetween.

In the head unit **17** according to the present embodiment of the invention, as illustrated in FIG. **13**, five recording heads **18** (**18***a* to **18***e*) are attached to the base plate portion **26***a*, each as a detachable head, in such a manner that these recording heads **18** are arranged in a row with a predetermined gap (denoted as d in FIG. **15**) each therebetween in the direction orthogonal to the direction of nozzle lines. The orthogonal direction mentioned above is the same as the main scan direction X and corresponds to a "direction in which . . . are arranged in a (the) row" according to an aspect of the invention. Accordingly, the orthogonal direction mentioned above is hereinafter referred to as "side-by-side-arrangement direction X". The five recording heads **18***a* to **18***e* are attached thereto in a state illustrated in FIG. **15**, specifically, in the following way. The sub tanks **37** (described later) of the five recording heads **18***a* to **18***e* are inserted into the housing space **35** through the head insertion opening **28** from below. The spacers **32** (refer to FIG. **12**) are interposed between the flanges of recording heads **18***a* to **18***e* and the base plate portion **26***a*. In this state, head-fixing screws (not shown) are driven into the fixing holes **29** through the attachment holes of the spacers **32**. The head-fixing screw is an example of a head fixing means according to an aspect of the invention. Besides the five recording heads **18***a* to **18***e*, a head protection member **23** is attached to the base plate portion **26***a* outside the head row at a position next to the recording head **18** that is located at one end in the side-by-side-arrangement direction X (rightmost head in FIG. **15**). The head protection member **23**, which is an example of a protection member according to an aspect of the invention, is provided thereat for the purpose of protecting a side of the rightmost recording head **18**. A more detailed explanation of the head protection member **23** will be given later. The structure of each of the head-fixing screws described above (i.e., its diameter, length, and thread pitch) is the same as that of each head-protection-member-fixing screw **42** for common mechanical design.

FIG. **16** is a perspective view that schematically illustrates an example of the structure of the recording head **18**, which is an example of a liquid ejecting head according to an aspect of the invention. Since the five recording heads **18**, which can be attached to the sub carriage **26**, have a common basic structure, one of them is shown in FIG. **16**.

The recording head **18** has a head case **52**. A flow passage unit (not shown) in which ink flow passages including pressure chambers that are in communication with nozzles **51** are formed and a pressure generating means (not shown) such as piezoelectric vibrators or heating elements for causing a pressure change in ink inside the pressure chambers are provided inside the head case **52**. A driving signal is supplied from the control unit of the printer **1** to the pressure generating means so as to drive the pressure generating means. The recording head **18** is configured to eject ink from the nozzles **51** onto a recording target medium such as recording paper as a result of the driving of the pressure generating means. The nozzles **51** from which ink is ejected are formed in rows, that is, as nozzle lines **56** (a kind of nozzle groups), in the nozzle formation surface **53** of each of the plurality of recording heads **18**. Two nozzle lines **56** are formed next to each other as viewed in the direction orthogonal to the nozzle-line direction. Each of the nozzle lines **56** is made up of 360 nozzle orifices that are formed at a pitch of, for example, 360 dpi. When the recording head **18** is in a standby state at the home position and is not being driven, in other words, when the recording head **18** is not performing the operation of printing an image, etc., on a recording target medium such as recording paper, a moisture retention cap **59** or a suction cap **60**, which will be described later, covers the nozzle lines **56** for moisture retention. With such capping, the evaporation of an ink solvent through the nozzles **51** is suppressed. Therefore, it is possible to prevent the viscosity of ink from increasing.

The head case **52** is a hollow box-like member. The flow passage unit is fixed at the front-end side of the head case **52** with the nozzle formation surface **53** exposed to the outside. The pressure generating means and the like are housed in the inner space of the head case **52**. The sub tank **37**, from which ink is supplied to the flow passage unit, is attached to the base-surface side (the upper-surface side) of the head case **52**. The base surface is a surface opposite to the nozzle formation surface **53**. The flange portion **52***a* is formed at each of two sides in the nozzle-line direction at the upper-surface side of the head case **52**. Each of the two flange portions **52***a* extends sideward. The spacer attachment hole **54**, which corresponds to the aforementioned head insertion hole of the spacer **32**, is formed through each of the two flange portions **52***a*. The spacer-fixing screw **27** is driven into the spacer attachment hole **54** when the spacer **32** is fixed to the flange portion **52***a*.

The sub tank **37** is a member through which ink flowing in from the flow passage member **24** can be supplied toward the pressure chambers of the recording head **18**. The sub tank **37** has a self-sealing function for controlling the flow of ink into the pressure chambers by opening and closing its valve depending a change in inner pressure. The flow passage con-

nection portion **38**, to which the connection flow passage **40** of the flow passage member **24** is connected, is provided at both end regions in the nozzle-line direction in the rear-end surface (the upper surface) of the sub tank **37**. A ring-shaped gasket (not shown) is fitted in the flow passage connection portion **38**. The gasket ensures the liquid-tight connection of the connection flow passage **40** to the flow passage connection portion **38**. Two driving substrates (not shown) are provided inside the sub tank **37**. The driving substrates supply driving signals to the pressure generating means. A flexible cable **55** (wiring member) is electrically connected to each of the two driving substrates. The two flexible cables **55** are wired with exposure at the rear-end-surface side of the sub tank **37**. The flexible cables **55** are connected to the signal cable **15**. The driving signals, etc., sent through the signal cable **15** from the control unit of the printer **1** flow through the flexible cables **55** to be supplied to the pressure generating means via the driving substrates.

The head protection member **23** is a member that protects the recording head **18** (in particular, a side of the recording head **18** that is located at an end in the side-by-side-arrangement direction X) from, for example, recording paper during recording operation. For example, the head protection member **23** is made of synthetic resin. In the present embodiment of the invention, a single head protection member **23** is detachably attached (screwed) to the base plate portion **26***a* next to the rightmost recording head **18** in the side-by-side-arrangement direction X. That is, the head protection member **23** is located outside the row of the recording heads **18** attached to the sub carriage **26** next to the recording head **18***a*, which is located at the right end in the side-by-side-arrangement direction X. There is a gap d, which is the same as the aforementioned gap d between each two recording heads **18**, between the head protection member **23** attached to the base plate portion **26***a* and the recording head **18** located next to the head protection member **23** (in the present embodiment of the invention, the recording head **18***a*, which is located at the right end in the side-by-side-arrangement direction X). The gap d is set at a value that is small enough (for example, approximately 0.2 mm or shorter) so that recording paper (for example, 0.3 mm) or the like cannot get into it. That is, the plurality of recording heads **18** and the head protection member **23** are arranged at equal spaces, meaning that the clearance between the head protection member **23** and the recording head **18***a* is the same as the clearance between each two recording heads **18** attached to the sub carriage **26**.

In addition, as illustrated in FIG. **13**, the dimensions of the head protection member **23** in a plan view (i.e., depth in the nozzle-line direction and width in the direction orthogonal to the direction of a nozzle line) are approximately the same as those of the recording head **18**. The aforementioned plurality of fixing holes **41** is formed in the lower surface of the base plate portion **26***a* at positions corresponding to the attachment area of the head protection member **23**. Specifically, in the present embodiment of the invention, two fixing holes **41** are formed at each of two sides as viewed in a direction corresponding to the direction of a nozzle line for the attachment area of the head protection member **23** with the head insertion opening **28** formed between the two sides. In other words, the plurality of (i.e., four) fixing holes **41** is formed at four places respectively for the attachment area of the head protection member **23**. The aforementioned head-protection-member-fixing screws **42** are driven into the fixing holes **41** respectively to fix the head protection member **23**. As explained earlier, the structure of each fixing hole **41** is the same as that of each fixing hole **29** for common mechanical design. A relationship between the positions of the fixing holes **41** relative to the position of the attachment of the head protection member **23** is the same as a relationship between the positions of the fixing holes **29** relative to the position of the attachment of the recording head **18**. For this reason, the position of the attachment of the head protection member **23** is not limited to the outside of the row of the recording heads **18** attached to the base plate portion **26***a* (sub carriage **26**) next to the recording head **18***a*, which is located at the right end in the side-by-side-arrangement direction X. The head protection member **23** can be detachably attached at the position of any of the recording heads **18**. In other words, since the fixing holes **29** and the fixing holes **41** share a common structure, and since the head-fixing screws and the head-protection-member-fixing screws **42** share a common structure, it is possible to attach the head protection member **23** to the base plate portion **26***a* by placing the head protection member **23** at an unoccupied position of the recording head **18** and driving the head-protection-member-fixing screws **42** into the fixing holes **29** respectively. The head protection member **23** can be detached from the attachment position by unscrewing the head-protection-member-fixing screws **42**.

As illustrated in FIGS. **15**, **17**A, **17**B, and **17**C, the head protection member **23** has an inclined plane **23***c* at a front-end portion **23***a*, which is a part opposite to a sub-carriage-attachment-side part and faces a recording target medium during recording operation. The inclined plane **23***c* is sloped up from the head side (**18***a*) toward the opposite side, that is, outward, with respect to the side-by-side-arrangement direction X. In other words, the inclined plane **23***c* is formed as a slope that is continuous from a front-end surface **23***b*, which is a surface of the front-end portion **23***a* of the head protection member **23** that is parallel with the nozzle formation surface **53**, to a side of the head protection member **23** away from the plurality of recording heads **18**, which means that it is formed by obliquely cutting off a corner of the front-end portion **23***a* that is not closer to the plurality of recording heads **18** or as if the corner has been cut off obliquely. The front-end surface **23***b* of the front-end portion **23***a* is located at a position that is not closer to the sub carriage **26** in comparison with the nozzle formation surface **53** of each of the plurality of recording heads **18** attached to the sub carriage **26**. Because of such a structure, it is possible to protect the adjacent recording head **18** against shock due to collision with recording paper or the like, thereby preventing the aligned recording head **18** from becoming misaligned with respect to the sub carriage **26**. As an example of a modified structure, the front-end surface **23***b* of the front-end portion **23***a* may be level with the nozzle formation surface **53** of each of the plurality of recording heads **18** attached to the sub carriage **26**. The gist is that the head protection member **23** can shield a side of the recording head **18** for protection.

A part of the inclination **23***c* is dented as a recess **23***d* toward the sub carriage **26**. In the present embodiment of the invention, two slope regions of the plane **23***c* are formed at respective ends of the head protection member **23** in the direction orthogonal to the side-by-side-arrangement direction X. The recess **23***d* is formed between the two slope regions of the plane **23***c* (at the center). The opening size L**1** of the recess **23***d* in the direction orthogonal to the side-by-side-arrangement direction X is smaller (narrower) than the size of the head protection member **23** in this direction and larger (wider) than the size of the moisture retention cap **59** or the suction cap **60** in this direction. For example, in the direction orthogonal to the side-by-side-arrangement direction X, the head protection member **23**, the recess **23***d*, and the moisture retention cap **59** or the suction cap **60** have the size (width) of 61.7 mm, 59.7 mm, and 56.0 mm, respectively.

When projected vertically as a size in the side-by-side-arrangement direction X, the opening size L2 of the recess **23***d* is the same as the projected size of the inclined plane **23***c* in this direction. As is evident from the above, each of the two slope regions of the plane **23***c* according to the present embodiment of the invention is formed as an inclined surface of the front-end portion **23***a* of the head protection member **23** with the recess **23***d* formed therebetween. The recess **23***d* is made up of a first recess inclined plane **23***e* and a second recess inclined plane **23***f* that have angles of inclination different from each other. The first recess inclined plane **23***e* is an inner part that is located closer to the plurality of recording heads **18** than the second recess inclined plane **23***f* in the side-by-side-arrangement direction X. The first recess inclined plane **23***e* is steeper than the inclined plane **23***c* with respect to a plane that is parallel with the nozzle formation surface **53**. For example, the angle of inclination of the inclined plane **23***c* with respect to a plane that is parallel with the nozzle formation surface **53** is 23.3°. The angle of inclination of the first recess inclined plane **23***e* with respect thereto is 55.0°. The first recess inclined plane **23***e* is continuous at its lower end from the front-end surface **23***b*. At its upper end, the first recess inclined plane **23***e* is continuous to the lower end of the second recess inclined plane **23***f*. The second recess inclined plane **23***f* is an outer part that is located outside the first recess inclined plane **23***e* in the side-by-side-arrangement direction X. The second recess inclined plane **23***f* is gentler than the inclined plane **23***c* with respect to a plane that is parallel with the nozzle formation surface **53**. For example, the angle of inclination of the second recess inclined plane **23***f* with respect to a plane that is parallel with the nozzle formation surface **53** is 12.4°. The second recess inclined plane **23***f* is continuous at its lower end from the upper end of the first recess inclined plane **23***e*. At its upper end, the second recess inclined plane **23***f* is continuous to a side face of the head protection member **23**. That is, as illustrated in FIG. **17**C, in a front cross-sectional view taken in the side-by-side-arrangement direction X, the recess **23***d* is formed as a triangular cavity inside the inclined plane **23***c*.

Next, the aforementioned plurality of capping members (hereinafter referred to as "cap group **58**") will now be explained. The cap group **58** is provided under the carriage assembly **3** on standby at the home position. The cap group **58** includes a plurality of caps for covering the nozzles **51** formed in the surface regions **53** of the plurality of recording heads **18** so as to keep them in a sealed state. The number of the caps is the same as that of the recording heads **18** of the head unit **17**. The caps are arranged in the side-by-side-arrangement direction X with the same gap each therebetween as the gap of the recording heads **18** each therebetween. In the present embodiment of the invention, one cap in the cap group **58** is the suction cap **60**, which makes it possible to suck ink out of the nozzles **51** in a state in which the nozzle formation surface **53** is capped. Each of the other caps is the moisture retention cap **59**, which does not have such a suction-capping function. Each of the caps **59** and **60** is an open-topped tray-like member that resembles a letter "U" in a cross section. The top of the sidewalls of the cap can be brought into contact with the nozzle formation surface **53** of the recording head **18**. Each of these caps is made of an elastic resin material such as elastomer or the like. These caps have the same dimensions and shape. The outer edge of the top of the sidewalls of each of the caps **59** and **60** is rounded (or tapered). When in a capping state, the moisture retention cap **59** prevents the viscosity of ink in the neighborhood of the nozzles **51** from increasing due to drying. The capping state is a state in which the top of the sidewalls of the cap is in contact with the nozzle formation surface **53** of the recording head **18** located at the home position to cover the nozzles **51** (the nozzle lines **56**). In other words, the moisture retention cap **59** has a function of keeping ink moisturized in the neighborhood of the nozzles **51**. The suction cap **60** also prevents the viscosity of ink in the neighborhood of the nozzles **51** from increasing due to drying when in a state in which the top of the sidewalls thereof is in contact with the nozzle formation surface **53** of the recording head **18** located at the home position to cover the nozzles **51** (the nozzle lines **56**). Being equipped with a sucking means **62**, the suction cap **60** has a function of sucking ink out of the nozzles **51** by using a suction force generated by a pump (not shown) in addition to the moisture retention function described above. In this respect, the suction cap **60** is different from the moisture retention cap **59**. The sucking means **62** includes a communication passage **62***a*, a tube (not shown), the pump, and the like. One end of the communication passage **62***a* is open toward the opening of the suction cap **60**. The other end of the communication passage **62***a* is open at the lower surface of a cap-supporting member **61**, which will be described later. The tube is connected to the other end of the communication passage **62***a* at the lower surface of the cap-supporting member **61** for liquid-tight communication. In a state in which the suction cap **60** is in contact with the nozzle formation surface **53** of the recording head **18** for capping (sealing) it, the pump makes the internal pressure of the space sealed by the suction cap **60** negative by applying a suction force thereto through the tube and the communication passage **62***a*. That is, the suction cap **60** is capable of not only sealing the nozzles **51** of the recording head **18** that is not being driven for moisture retention but also sucking ink out of the nozzles **51** by using the sucking means **62** in suction operation performed when, for example, the recording head **18** has not been driven for a long time or when the inner flow passages of the recording head **18** are filled with ink at the time of ink-cartridge replacement.

As illustrated in FIG. **18** (in particular, refer to FIGS. **18**A, **18**B, and **18**C), the cap group **58** according to the present embodiment of the invention is made up of four moisture retention caps **59** and one suction cap **60**. The suction cap **60** is located at the other end in the side-by-side-arrangement direction X (left end in FIG. **18**). To cap the nozzle formation surface **53** of each of the five recording heads **18***a* to **18***e* that are located at the home position, the recording head **18***e*, which is located at the other end in the side-by-side-arrangement direction X, that is, the end opposite to the one end where the recording head **18***a* is provided next to the head protection member **23**, which is provided outside the head row, is positioned to face the suction cap **60**. Accordingly, the remaining four recording heads, **18***a*, **18***b*, **18***c*, and **18***d*, are positioned to face the four moisture retention caps **59**, respectively. The above position of the cap group **58** relative to the positions of the recording heads **18***a* to **18***e* in the side-by-side-arrangement direction X is hereinafter referred to as "reference position".

The cap-supporting member **61** supports the cap group **58**. The cap-supporting member **61** moves up and down when driven by an elevation mechanism (not shown). The cap-supporting member **61** is set in a lower position or moved to the lower position when the cap group **58** is not used for performing capping/suction operation for the plurality of recording heads **18**. In this state, the moisture retention caps **59** and the suction cap **60** are away from the nozzle formation surface **53** thereof (first state). To perform capping/suction operation for the recording head(s) **18**, the cap-supporting member **61** is lifted so as to bring the moisture retention

cap(s) **59**/suction cap **60** into contact with the recording head(s) **18** on standby at the home position (second state, capping/sucking state).

Next, suction operation that is performed when the printer **1** having the above structure has not been driven for a long time will now be explained. The cap group **58** is in a standby state at the reference position. Depending on the operation state of the recording heads **18**, the cap group **58** is either in the first state, in which the moisture retention caps **59** and the suction cap **60** are away from the nozzle formation surface **53** thereof, or in the second state, in which the moisture retention caps **59** and the suction cap **60** are in contact with the nozzle formation surface **53** thereof. In the following description, a case where suction operation is started from the second state after the idling of the printer **1** for a long time is explained. Detecting that the printer **1** has not been driven for a predetermined length of time in the second state, the control unit of the printer **1** causes the suction pump to operate so as to suck ink out of the nozzles **51** of the suction target head, that is, the recording head **18***e*, with which the suction cap **60** is in contact (refer to FIG. **18**A). After the completion of suction operation for the recording head **18***e*, the cap-supporting member **61** is moved down. This means that the cap group **58** is moved away from the recording heads **18***a* to **18***e*, that is, put into the first state (refer to FIG. **18**B). In this state, the carriage assembly **3** is moved in parallel inward, that is, from the home position toward the full position, with respect to the side-by-side-arrangement direction X. The amount of the above movement of the carriage assembly **3**, which is movement from the reference position, corresponds to the pitch of the recording heads **18** arranged in a row. As a result of such carriage movement by the head pitch, the suction cap **60** faces the next suction target head, that is, the recording head **18***d*. In addition, among the four moisture retention caps **59**, one that is located at one end in the side-by-side-arrangement direction X faces the head protection member **23**. Then, the cap-supporting member **61** is lifted from the shifted position to be put into the second state. Therefore, the three moisture retention caps **59** and the suction cap **60** are brought into contact with the edges of the surface regions **53** of the recording heads **18***a*, **18***b*, **18***c*, and **18***d*, respectively (refer to FIG. **18**C). The remaining one moisture retention cap **59** is lifted toward the head protection member **23** in this process. A part of this moisture retention cap **59** enters the recess **23***d* of the head protection member **23**, which is dented toward the sub carriage **26**. The moisture retention cap **59** is not brought into contact with the head protection member **23** because the recess **23***d*, which is located above the front-end surface **23***b* and the inclined plane **23***c*, can accommodate the part of the moisture retention cap **59**, which is allowed to escape into the recess **23***d* beyond the inclined plane **23***c* when the cap-supporting member **61** is lifted (refer to FIG. **18**D). In this state, the suction cap **60** is in contact with the recording head **18***d*, the suction target head, for sucking ink out of the nozzles **51** thereof. The same operation as above is repeated for the remaining three recording heads, **18***c*, **18***b*, and **18***a*, to suck ink out of the nozzles **51** thereof by means of the suction cap **60**. After the completion of suction operation for all of the recording heads **18***a* to **18***e*, the cap-supporting member **61** is moved down for transition to the first state. The carriage assembly **3** is thereafter moved toward the home position for return to the reference position. The cap-supporting member **61** is lifted again for return into the second state. Alternatively, the carriage assembly **3** is moved from the home position to a recording position (toward the full position) so as to start printing on a recording target medium. In the present embodiment of the invention, the carriage assembly **3** is moved in parallel with respect to the side-by-side-arrangement direction X. However, the scope of the invention is not limited to such an exemplary structure. For example, the cap-supporting member **61** may be equipped with a parallel movement mechanism for moving the cap group **58**. The gist is that the relative position of the cap group **58** and the head group **18** of the head unit **17** can be shifted in parallel with respect to the side-by-side-arrangement direction X.

As explained above, in the structure of the printer **1** according to the present embodiment of the invention, a part of the inclination **23***c* is dented as the recess **23***d*. In a state in which the suction cap **60** is in contact with any recording head (**18***a*, **18***b*, **18***c*, or **18***d*) other than the recording head **18***e*, which is one that is initially in contact with the suction cap **60** when it is in a standby state, more specifically, when one of the moisture retention caps **59** faces the head protection member **23** and, in addition, when each of the remaining moisture retention caps **59** (moisture retention cap(s) **59**) as well as (or) the suction cap **60** is in contact with the nozzle formation surface **53** of the recording head **18** in the second state, a part of the moisture retention cap **59** (or the suction cap **60**) facing the head protection member **23** is in the recess **23***d*, which ensures that the cap **59** (**60**) is not in contact with the head protection member **23**. Therefore, the sticking of ink from the cap **59** (**60**) onto the head protection member **23** does not occur. This makes it possible to prevent the transferred ink from dripping from the head protection member **23** onto recording paper, etc. and prevent recording paper, etc., from becoming stained by the transferred ink even when the collision of the recording paper with the head protection member **23** occurs. Moreover, since the head protection member **23** has the inclined plane **23***c*, when recording paper, etc., that is transported toward the head unit **17** from a side in the side-by-side-arrangement direction X collides with the inclined plane **23***c*, the head protection member **23** can guide the recording paper away from the sub carriage **26** along its inclined plane **23***c*, thereby lessening the impact of the collision. That is, in addition to its structure for avoiding contact with a cap at the time of capping operation, the head protection member **23** has a function of protecting the recording head **18**. Since the head protection member **23** has a contact-avoiding function, the structure described in the above embodiment of the invention can be adopted; a sucking means is provided in at least one cap in the cap group **58**; suction operation can be performed for all of the recording heads **18** sequentially through the relative movement of the recording heads **18** and the cap group **58**. That is, it is not necessary to provide the sucking means **62** as an individual sucking device for each of caps corresponding to the recording heads **18** even if a structure in which suction operation is performed for all of the recording heads **18** is adopted. The disclosed structure is advantageous because of simplicity. Furthermore, since the recess **23***d* of the head protection member **23** is made up of the first recess inclined plane **23***e* and the second recess inclined plane **23***f*, which are inclined in the same orientation as the orientation of the inclined plane **23***c* with different angles of inclination, even when recording paper, etc, gets into the recess **23***d*, the head protection member **23** can guide the recording paper downward along the second recess inclined plane **23***f* and the first recess inclined plane **23***e*, thereby lessening the impact of the collision.

The scope of the invention is not limited to the first embodiment described above. The invention may be modified, altered, changed, adapted, and/or improved without departing from the gist and/or spirit thereof apprehended by a person skilled in the art from explicit and implicit description given herein. Such a modification and the like are also encompassed

within the scope of the appended claims. For example, in a second embodiment of the invention, the head protection member **23** is provided at each of two sides in the side-by-side-arrangement direction X as illustrated in FIG. **19**. The recording heads **18***a* to **18***e* are arranged between the two head protection members **23**.

More specifically, in the second embodiment of the invention, one of the two head protection members **23** is located outside the row of the recording heads **18** next to the recording head **18***a*, which is located at the right end in the side-by-side-arrangement direction X, whereas the other of the two head protection members **23** is located outside the row of the recording heads **18** next to the recording head **18***e*, which is located at the left end in the side-by-side-arrangement direction X. As in the first embodiment of the invention, each of the two head protection members **23** according to the second embodiment of the invention has the inclined plane **23***c* at the front-end portion **23***a*, which is a part opposite to a sub-carriage-attachment-side part and faces a recording target medium during recording operation. The inclined plane **23***c* is sloped up from the head side (**18***a*, **18***e*) toward the opposite side, that is, outward, with respect to the side-by-side-arrangement direction X. Moreover, as in the first embodiment of the invention, the recess **23***d* is made up of the first recess inclined plane **23***e* and the second recess inclined plane **23***f*, which have angles of inclination different from each other. That is, as illustrated in FIG. **19**, the two head protection members **23** are provided symmetrically with the recording heads **18** arranged therebetween. With such a dual structure, it is possible to protect the recording heads **18** of the head unit **17** at both sides from recording paper, etc. that is transported during recording operation. Since the structure according to the second embodiment of the invention is the same as the structure according to the first embodiment of the invention except for the above point, an explanation thereof is not given here.

In the foregoing embodiments of the invention, a single suction cap **60** is provided. However, the scope of the invention is not limited to such an exemplary structure. Two or more suction caps **60** may be provided. The gist is that at least one of the caps constituting the cap group **58** is the suction cap **60**. In the foregoing embodiments of the invention, the head protection member(s) **23** is detachably attached to the base plate portion **26***a* of the sub carriage **26** by using screws. As a modification example, the head protection member(s) **23** may be molded as a part of the base plate portion **26***a* of the sub carriage **26**. In the foregoing embodiments of the invention, a structure for ejecting ink onto recording paper while reciprocating the plurality of recording heads **18** is taken as an example. However, the scope of the invention is not limited to such an exemplary structure. For example, a structure for ejecting ink from a plurality of fixed recording heads **18** onto recording paper while moving the recording paper can be adopted.

In the foregoing embodiments of the invention, the printer **1** is taken as an example of a liquid ejecting apparatus according to an aspect of the invention. Notwithstanding the foregoing, however, the invention can be applied to various liquid ejecting apparatuses. For example, the invention can be applied to, without any limitation thereto: a display manufacturing apparatus for the production of a color filter for a liquid crystal display or the like; an electrode manufacturing apparatus that is used for the electrode formation of an organic electroluminescence (EL) display, a surface/plane emission display (FED), and the like; and a chip manufacturing apparatus that is used for the production of biochips.

What is claimed is:

1. A liquid ejecting apparatus comprising:

a liquid ejecting head unit that includes a head-fixing member to which a plurality of liquid ejecting heads is attached in a row, each of the plurality of liquid ejecting heads having a nozzle surface and being capable of ejecting liquid toward a liquid ejection target medium from nozzles that are formed in the nozzle surface;

a protection member that is located outside the row of the liquid ejecting heads adjacent to a liquid ejecting head included in the liquid ejecting heads, the liquid ejecting head being located at an end in a direction in which the liquid ejecting heads are arranged in the row, the direction being hereinafter referred to as side-by-side-arrangement direction, the protection member being provided thereat for protecting a side of the adjacent liquid ejecting head; and

a cap group that is made up of a plurality of caps for covering the nozzles, the number of the caps being the same as that of the liquid ejecting heads of the liquid ejecting head unit, the caps being arranged in the side-by-side-arrangement direction with the same gap each therebetween as the gap of the liquid ejecting heads each therebetween,

wherein a relative position of the cap group and the liquid ejecting heads of the liquid ejecting head unit can be shifted in parallel with respect to the side-by-side-arrangement direction,

a state of the cap group can be changed into a state in which a cap included in the cap group is in contact with the nozzle surface;

the protection member has an inclined plane at a front-end portion, the inclined plane being sloped up from a liquid-ejecting-head side toward the opposite side, that is, outward, with respect to the side-by-side-arrangement direction,

a recess is formed at a part of the inclined plane, and

in a state in which one of the caps faces the protection member and, in addition, each of the remaining caps is in contact with the nozzle surface of the liquid ejecting head, a part of the cap facing the protection member is in the recess, which ensures that the cap is not in contact with the protection member.

2. The liquid ejecting apparatus according to claim **1**, wherein the recess includes a first recess inclined plane that is steeper than the inclined plane with respect to a plane that is parallel with the nozzle surface and a second recess inclined plane that is gentler than the inclined plane with respect to the plane that is parallel with the nozzle surface.

3. The liquid ejecting apparatus according to claim **1**, further comprising a sucking section, wherein at least one of the plurality of caps that make up the cap group can suck liquid out of the nozzles formed in the nozzle surface by using a suction force of the sucking section in a state in which the at least one cap is in contact with the nozzle surface.

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